United States Patent [19]

Furusawa et al.

[11] **Patent Number: 4,970,544**

[45] **Date of Patent: Nov. 13, 1990**

[54] **PAPER TRAY CONTROL SYSTEM**

[75] Inventors: **Tsutomu Furusawa; Kazuyuki Sakaguchi; Takanobu Suzuki,** all of Kanagawa, Japan

[73] Assignee: **Fuji Xerox Co., Ltd.,** Tokyo, Japan

[21] Appl. No.: **276,494**

[22] Filed: **Nov. 25, 1988**

[30] **Foreign Application Priority Data**

Nov. 26, 1987 [JP] Japan 62-298531
Dec. 1, 1987 [JP] Japan 304169

[51] **Int. Cl.**[5] **G03B 27/52**
[52] **U.S. Cl.** **355/24;** 355/204; 355/311
[58] **Field of Search** 355/133, 206, 204, 205, 355/311, 24

[56] **References Cited**

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4,306,803 12/1981 Donohue et al. 355/204

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62-194634 12/1987 Japan .
63-38152 3/1988 Japan .
63-59462 4/1988 Japan .
63-191173 8/1988 Japan .

OTHER PUBLICATIONS

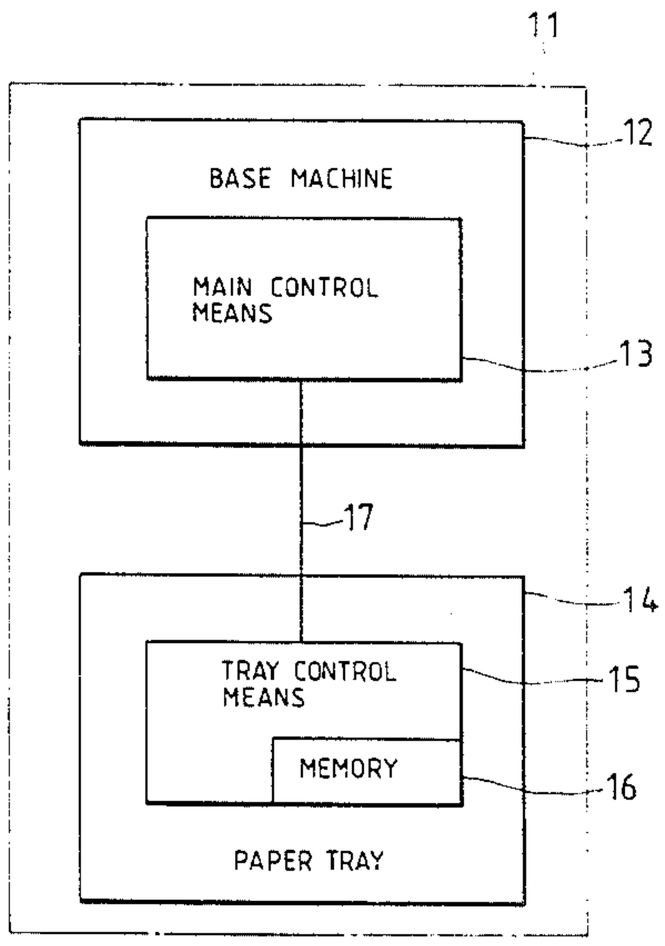
Sheikh, Siklandar, "A Programmable Digital Control System for Copying Machines", IEEE Transactions on Industrial Electronics and Control Instrumentation, vol. IECI—21, No. 1, pp. 25—33, Feb. 1984.

Primary Examiner—L. T. Hix
Assistant Examiner—D. Rutledge
Attorney, Agent, or Firm—Finnegan, Henderson, Farabow, Garrett, and Dunner

[57] **ABSTRACT**

A paper tray control system includes a recording apparatus for recording image data on a paper, to which additional devices are attachable; a paper tray installed in the recording apparatus as the additional devices for stocking the paper on which the image data has been recorded; and main controller for controlling the recording apparatus and for generating an instruction. The paper tray control system is further provided with a tray control separated from the main controller for controlling the paper tray; and a communication line connected between the main controller and the tray controller, wherein the tray controller receives the instruction from the main controller through the communication line to control the paper tray according to the instruction.

11 Claims, 37 Drawing Sheets



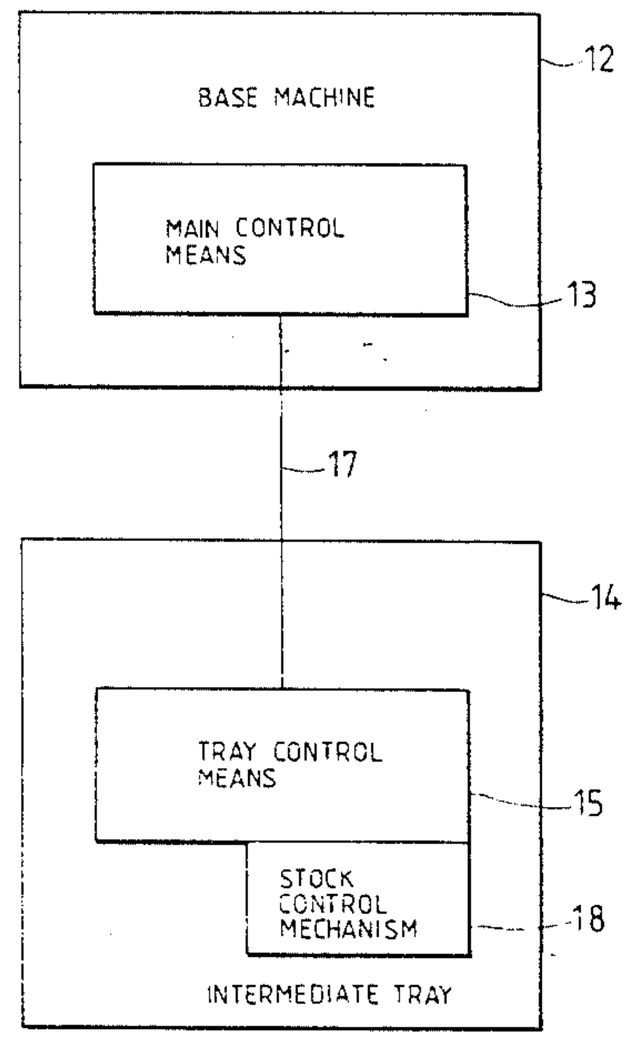


FIG. 1A

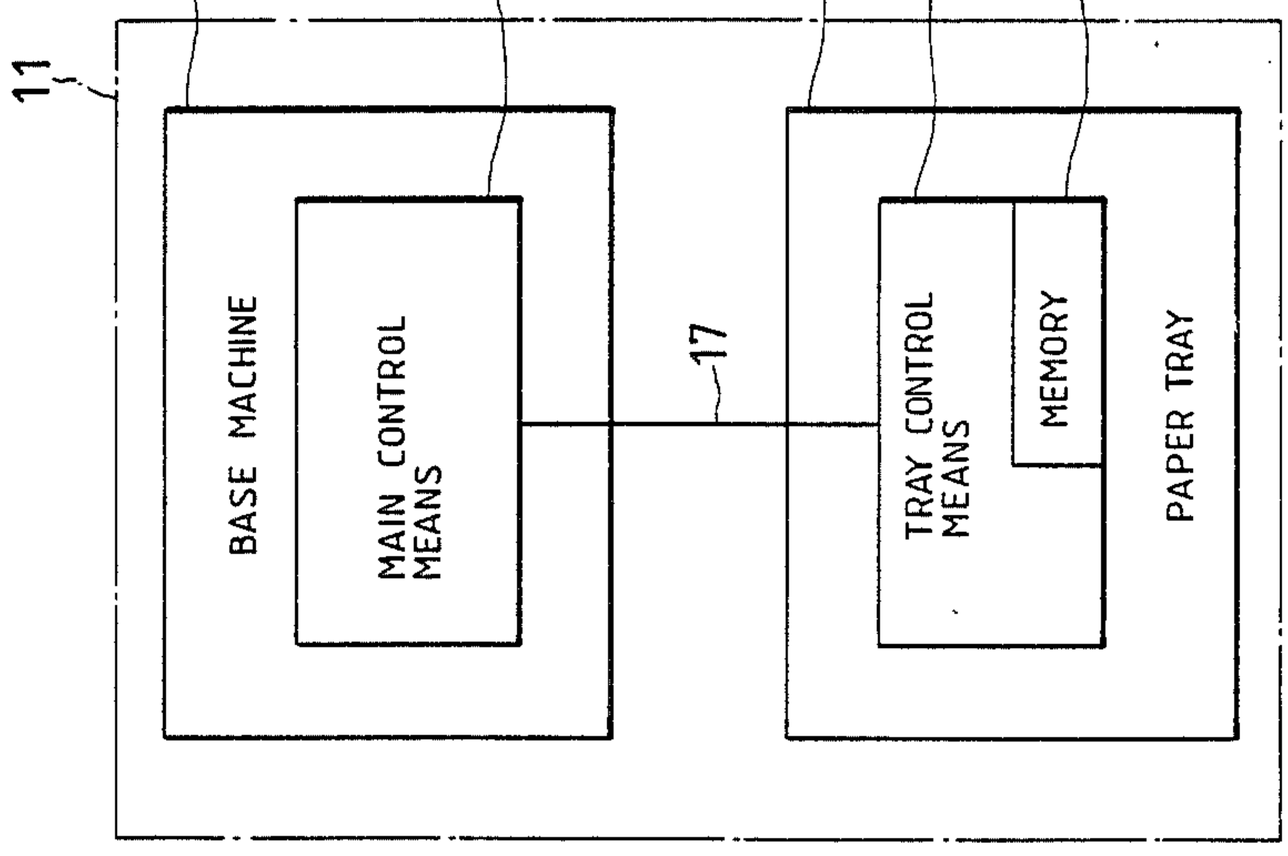

11
12
13
14
15
16
17
BASE MACHINE
MAIN CONTROL MEANS
TRAY CONTROL MEANS
MEMORY
PAPER TRAY

FIG. 1B

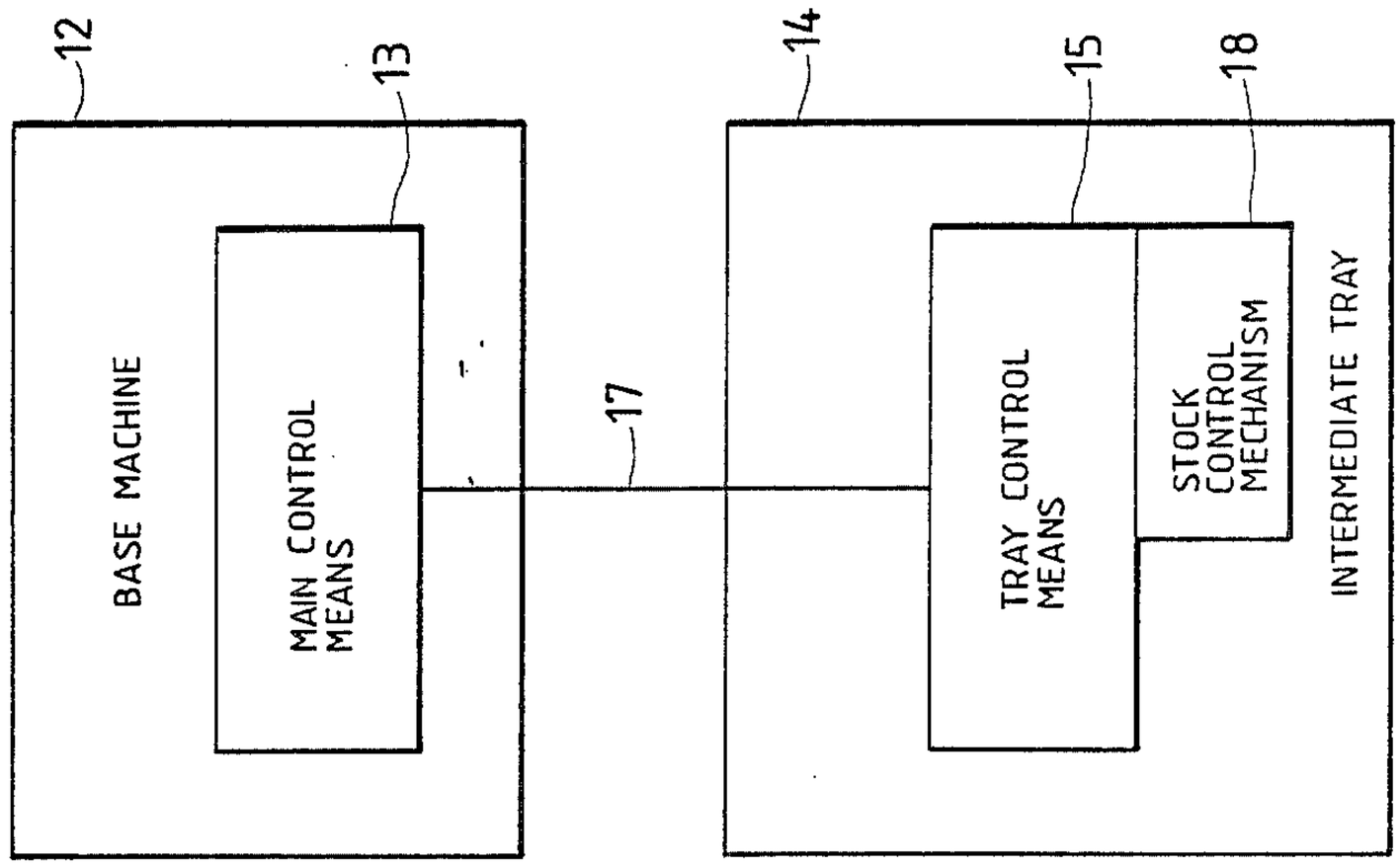

12
13
14
15
18
17
BASE MACHINE
MAIN CONTROL MEANS
TRAY CONTROL MEANS
STOCK CONTROL MECHANISM
INTERMEDIATE TRAY

FIG. 2

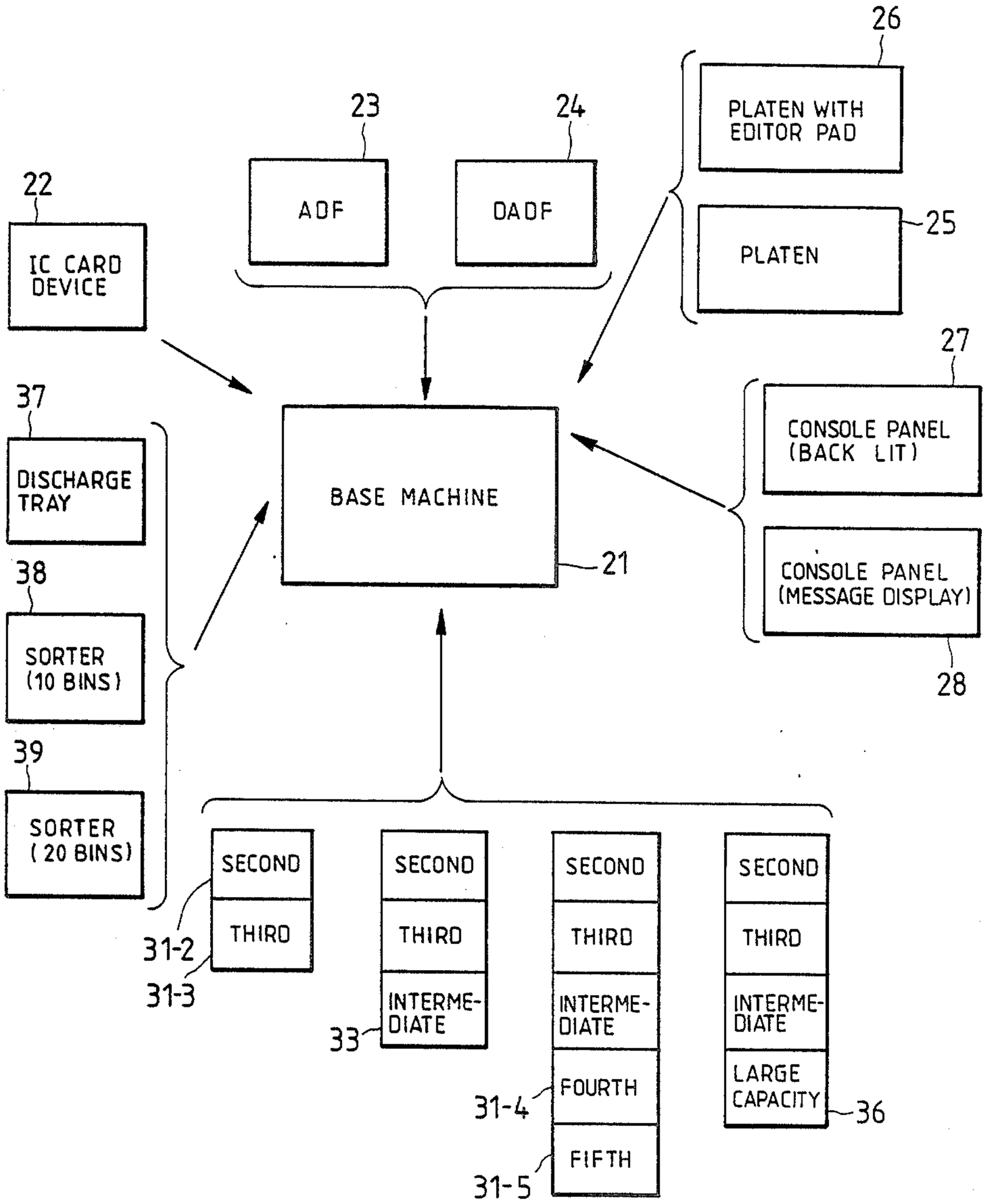

22
IC CARD DEVICE
23
ADF
24
DADF
26
PLATEN WITH EDITOR PAD
25
PLATEN
27
CONSOLE PANEL (BACK LIT)
CONSOLE PANEL (MESSAGE DISPLAY)
28
37
DISCHARGE TRAY
38
SORTER (10 BINS)
39
SORTER (20 BINS)
BASE MACHINE
21
SECOND
THIRD
31-2
31-3
SECOND
THIRD
INTERME-DIATE
33
SECOND
THIRD
INTERME-DIATE
FOURTH
31-4
FIFTH
31-5
SECOND
THIRD
INTERME-DIATE
LARGE CAPACITY
36

FIG. 3

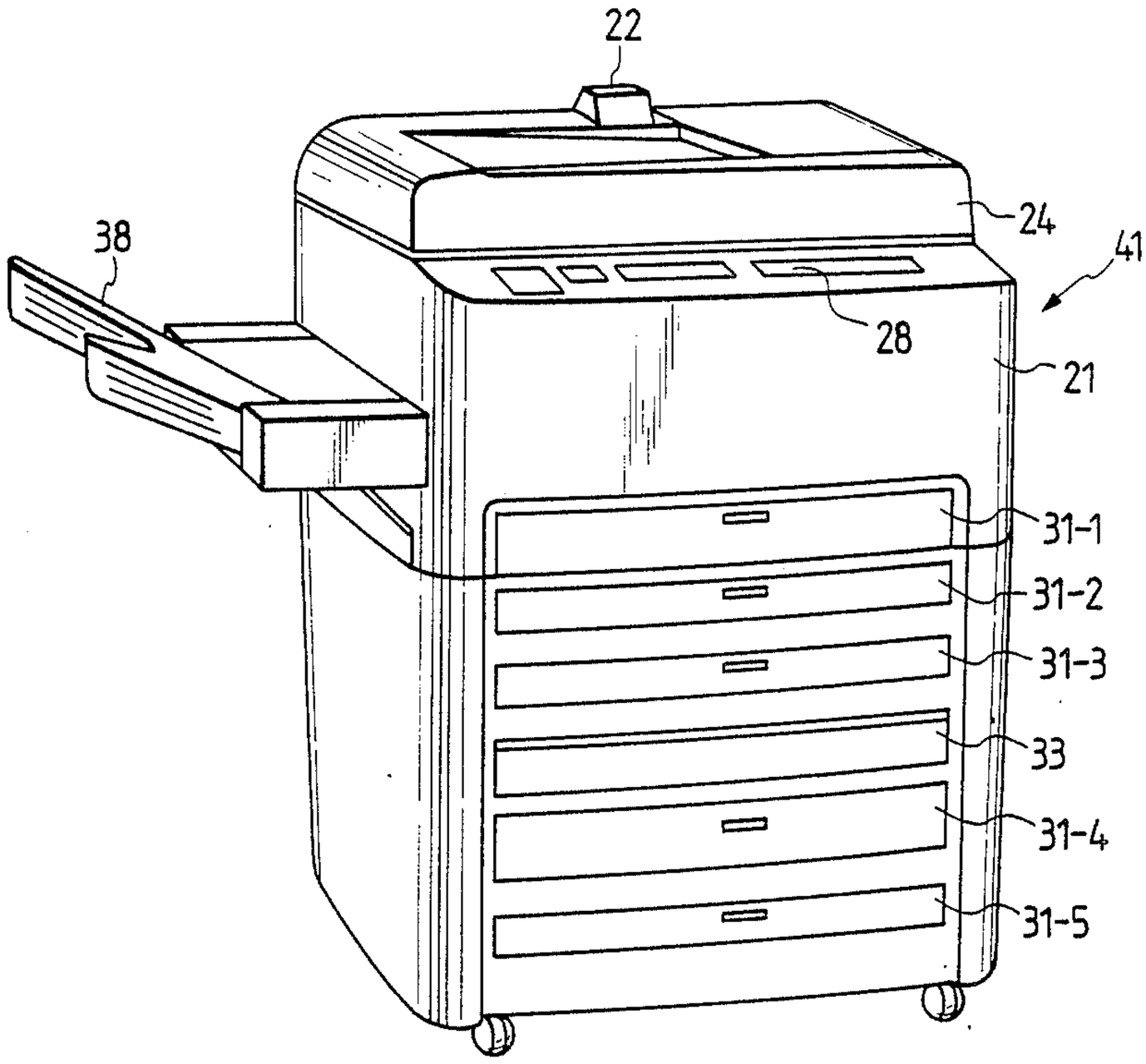


FIG. 4

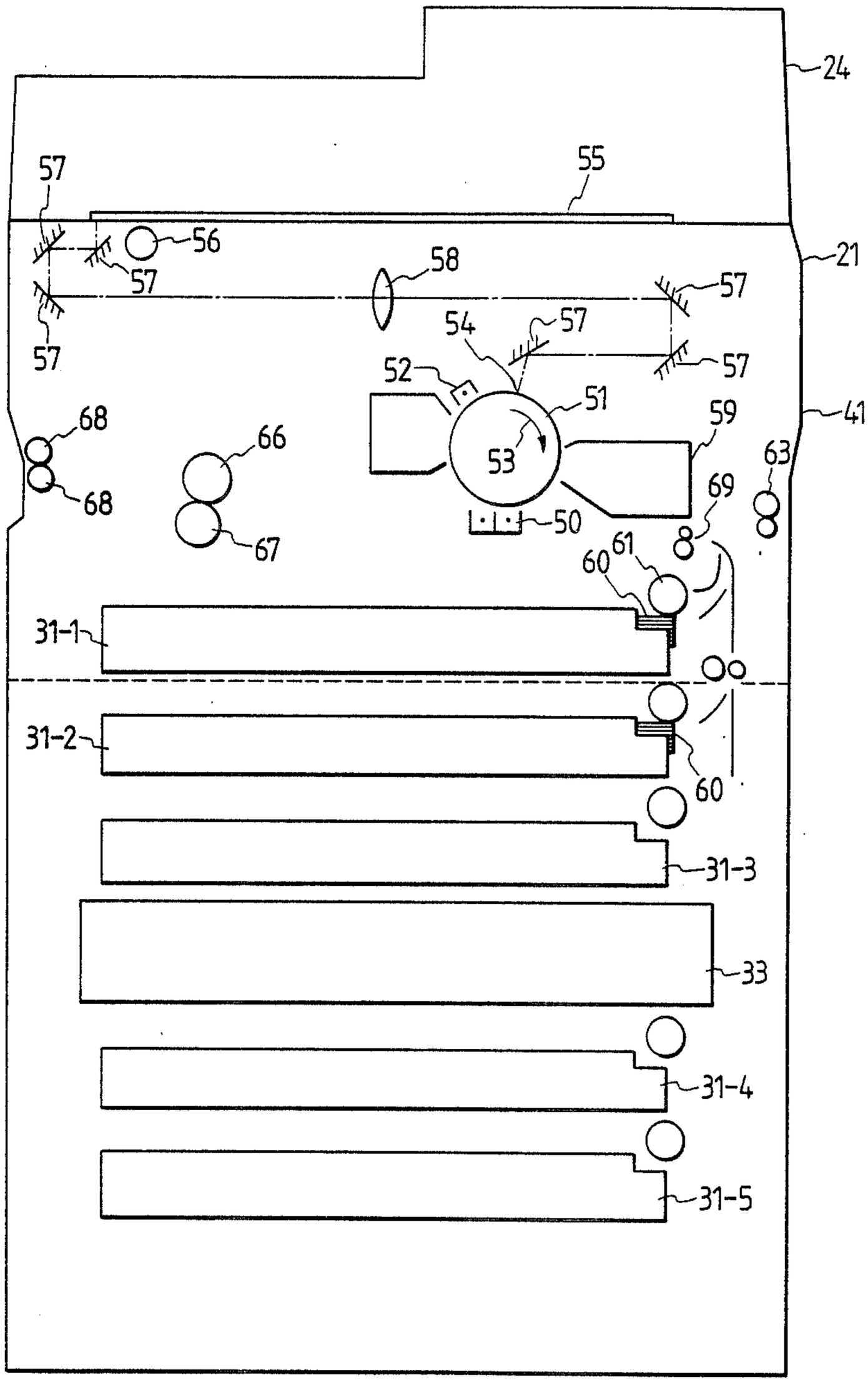

24
55
57
56
57
58
57
57
54
57
57
52
51
59
41
68
68
66
67
53
50
63
69
60
61
31-1
31-2
60
31-3
33
31-4
31-5

FIG. 5

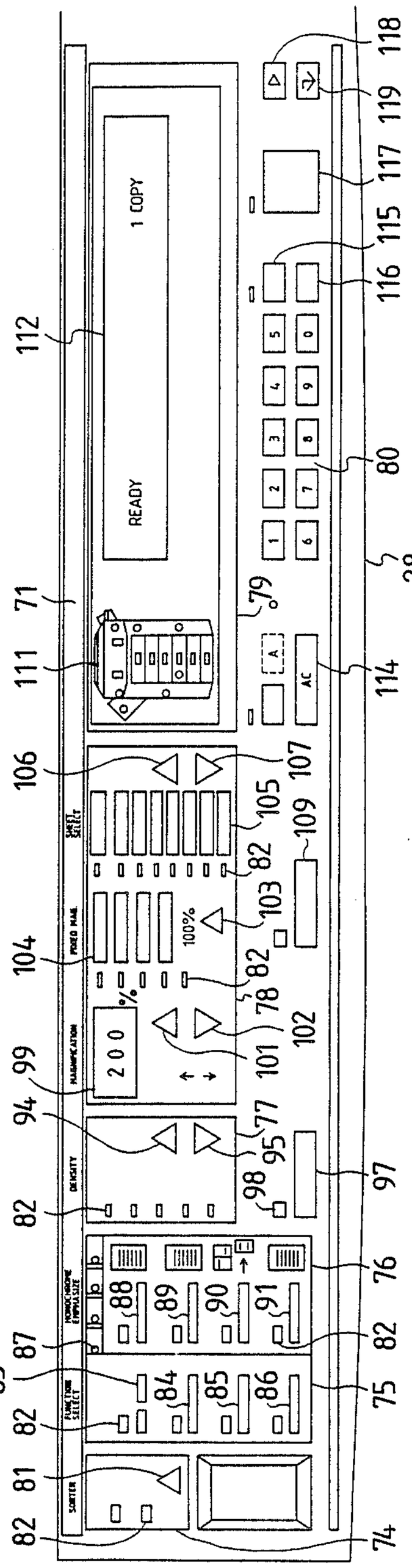

1 COPY
READY
A
AC
200
%
100%
PHOTO MODE
MAGNIFICATION
DENSITY
MONOCHROME EMPHASIS SIZE
FUNCTION SELECT
SORTER
112
71
111
106
107
104
105
109
103
82
99
94
78
101
102
77
95
98
97
88
89
90
91
76
87
83
84
85
86
75
81
74
118
119
117
115
116
80
28
79
114

FIG. 6

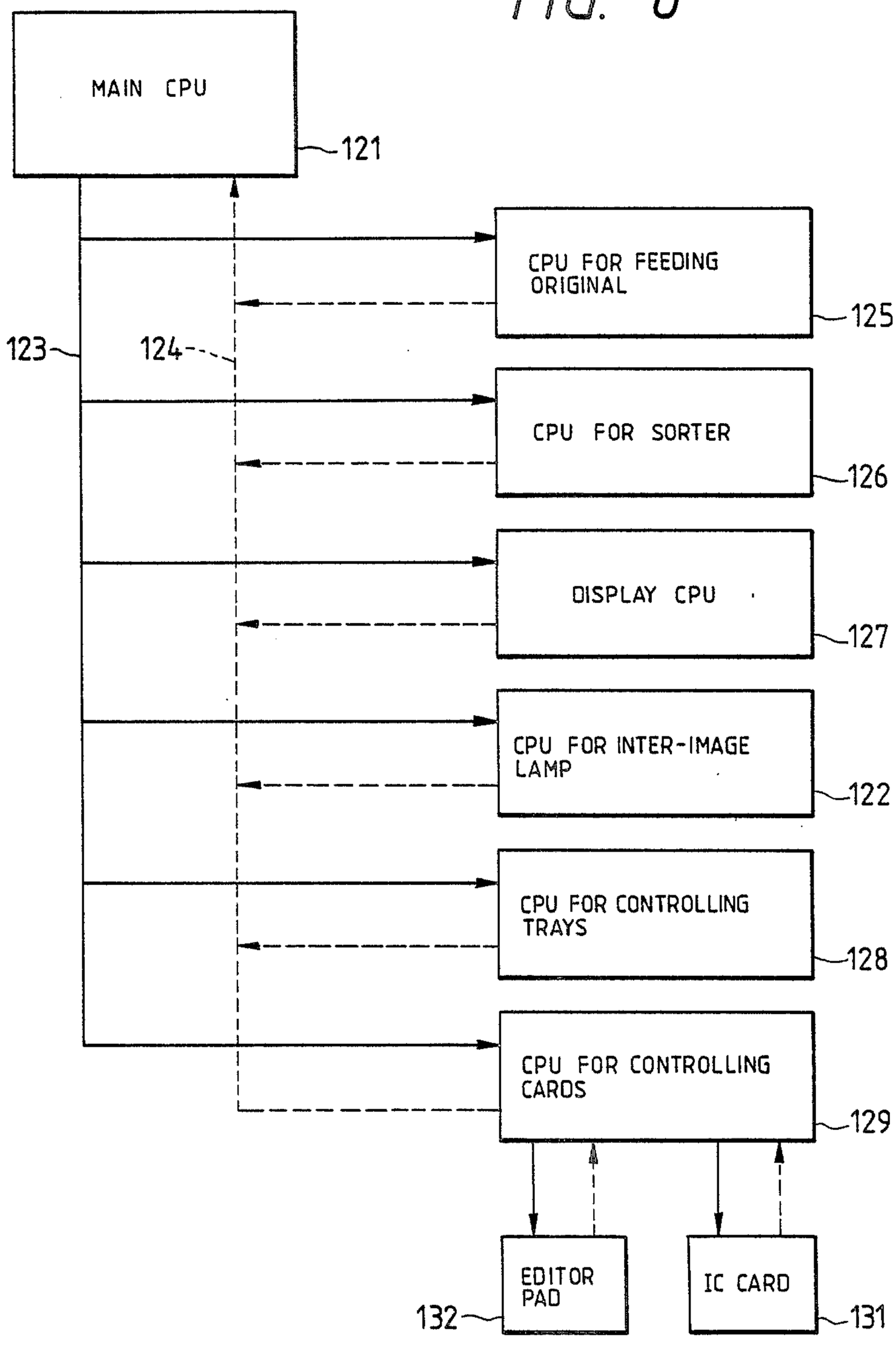

MAIN CPU
121
123
124
CPU FOR FEEDING ORIGINAL
125
CPU FOR SORTER
126
DISPLAY CPU
127
CPU FOR INTER-IMAGE LAMP
122
CPU FOR CONTROLLING TRAYS
128
CPU FOR CONTROLLING CARDS
129
EDITOR PAD
132
IC CARD
131

FIG. 7

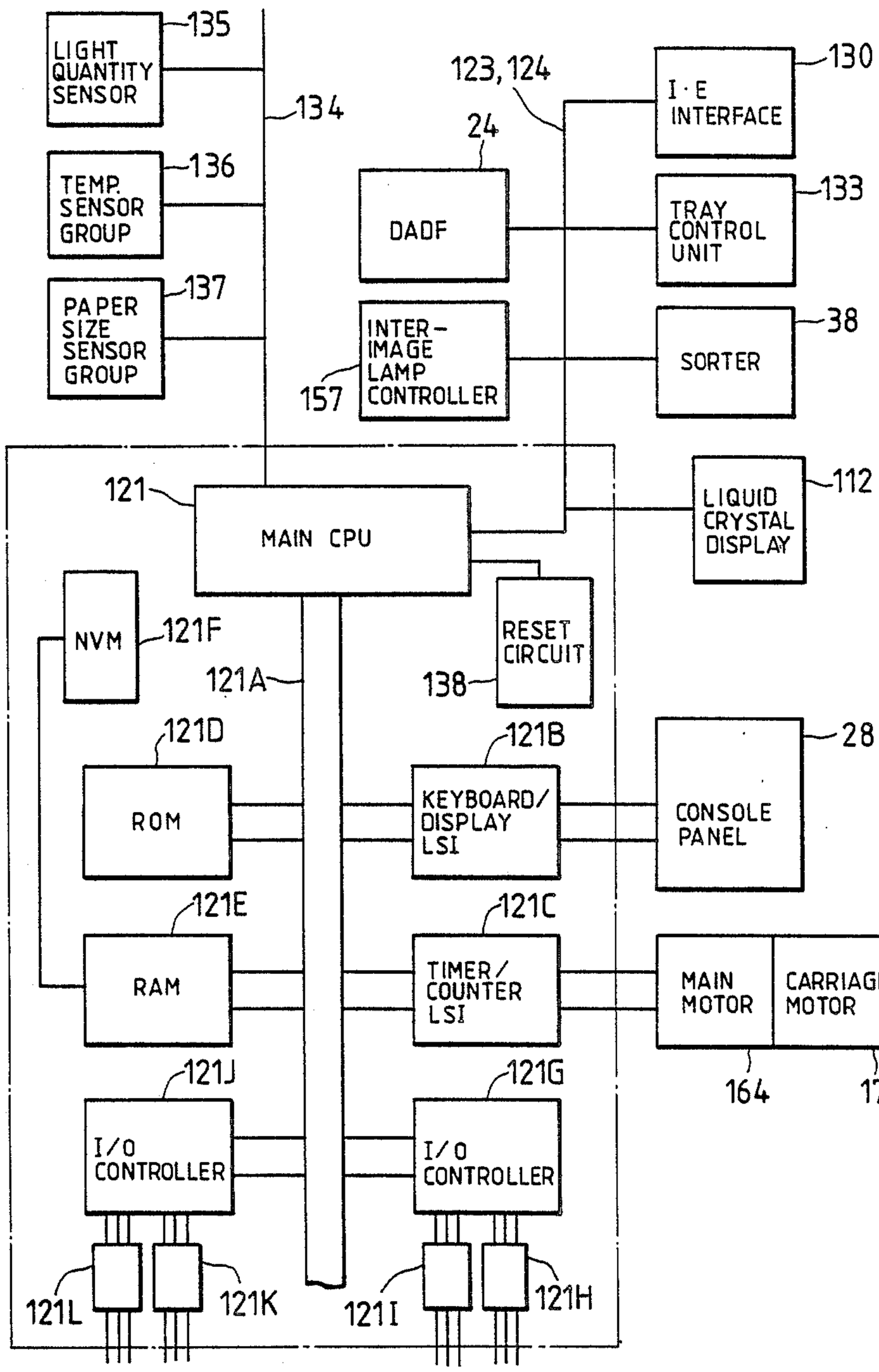

LIGHT QUANTITY SENSOR
135
134
TEMP. SENSOR GROUP
136
PAPER SIZE SENSOR GROUP
137
123, 124
24
I·E INTERFACE
130
DADF
TRAY CONTROL UNIT
133
INTER-IMAGE LAMP CONTROLLER
157
SORTER
38
121
MAIN CPU
LIQUID CRYSTAL DISPLAY
112
NVM
121F
121A
RESET CIRCUIT
138
121D
121B
ROM
KEYBOARD/ DISPLAY LSI
CONSOLE PANEL
28
121E
121C
RAM
TIMER/ COUNTER LSI
MAIN MOTOR
CARRIAGE MOTOR
164
171
121J
121G
I/O CONTROLLER
I/O CONTROLLER
121L
121K
121I
121H

FIG. 8

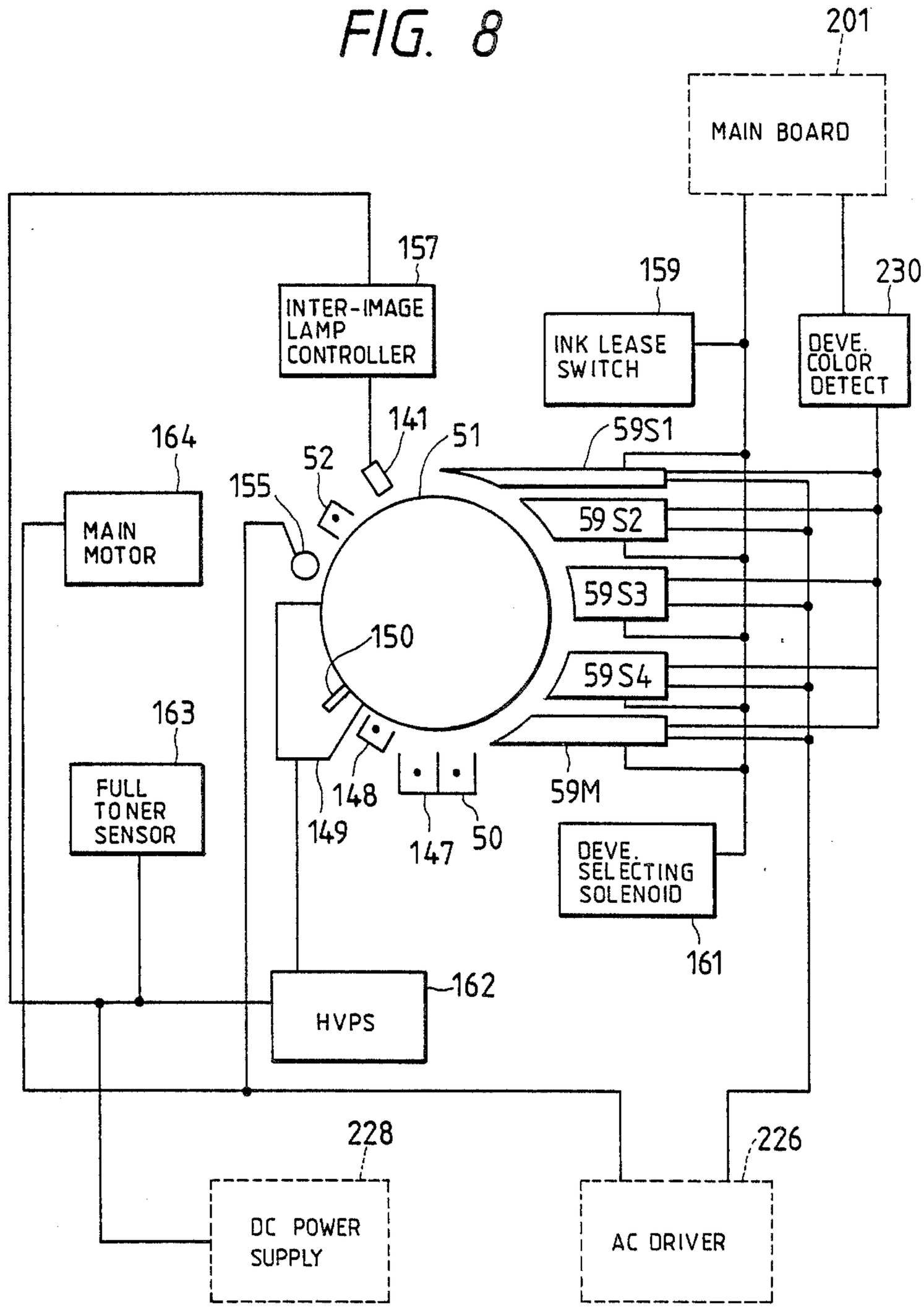

201
MAIN BOARD
157
INTER-IMAGE LAMP CONTROLLER
159
INK LEASE SWITCH
230
DEVE. COLOR DETECT
164
MAIN MOTOR
141
52
51
155
59S1
59 S2
59 S3
59 S4
59M
150
163
FULL TONER SENSOR
148
149
147
50
DEVE. SELECTING SOLENOID
161
162
HVPS
228
DC POWER SUPPLY
226
AC DRIVER

FIG. 9

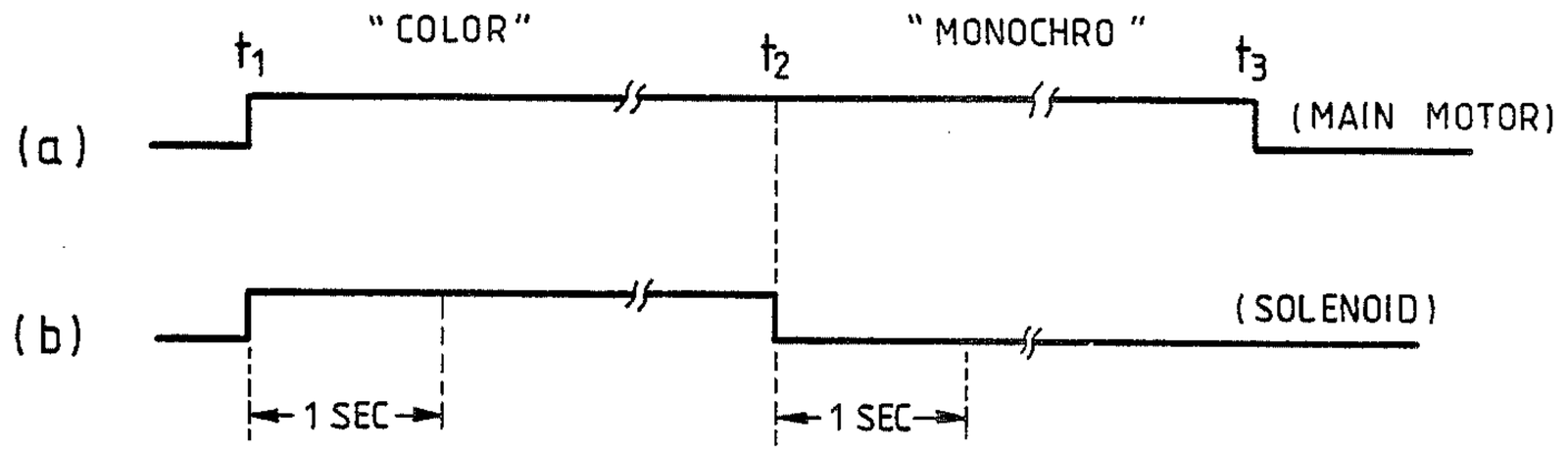

t1
" COLOR "
t2
" MONOCHRO "
t3
(MAIN MOTOR)
(a)
(b)
(SOLENOID)
1 SEC
1 SEC

FIG. 10

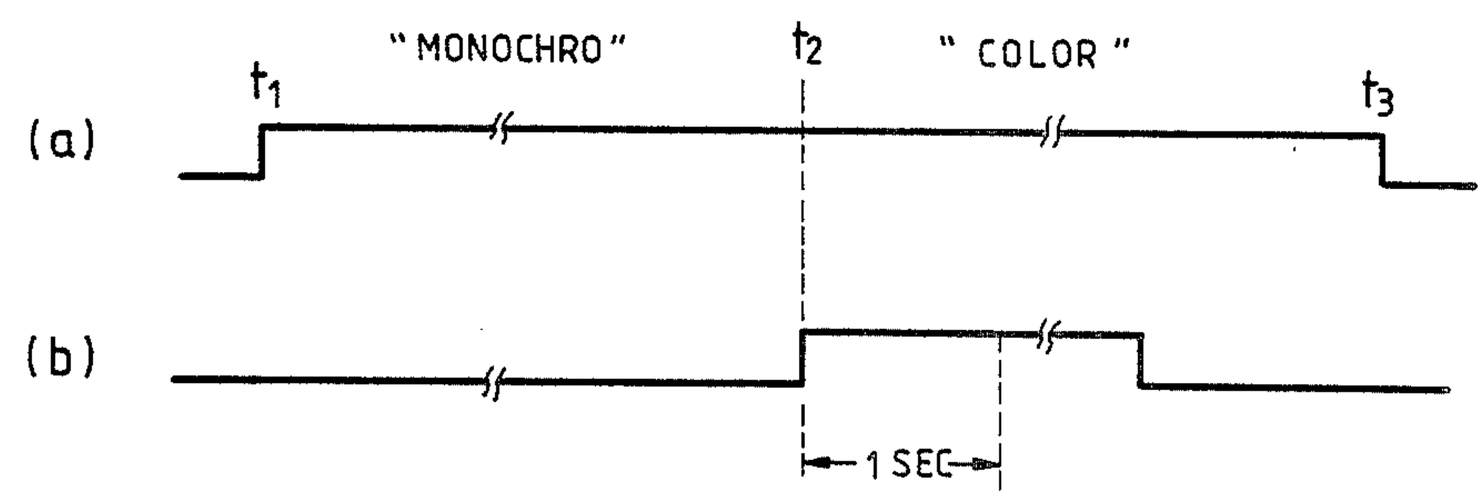

" MONOCHRO "
t2
" COLOR "
t1
t3
(a)
(b)
1 SEC

FIG. 11

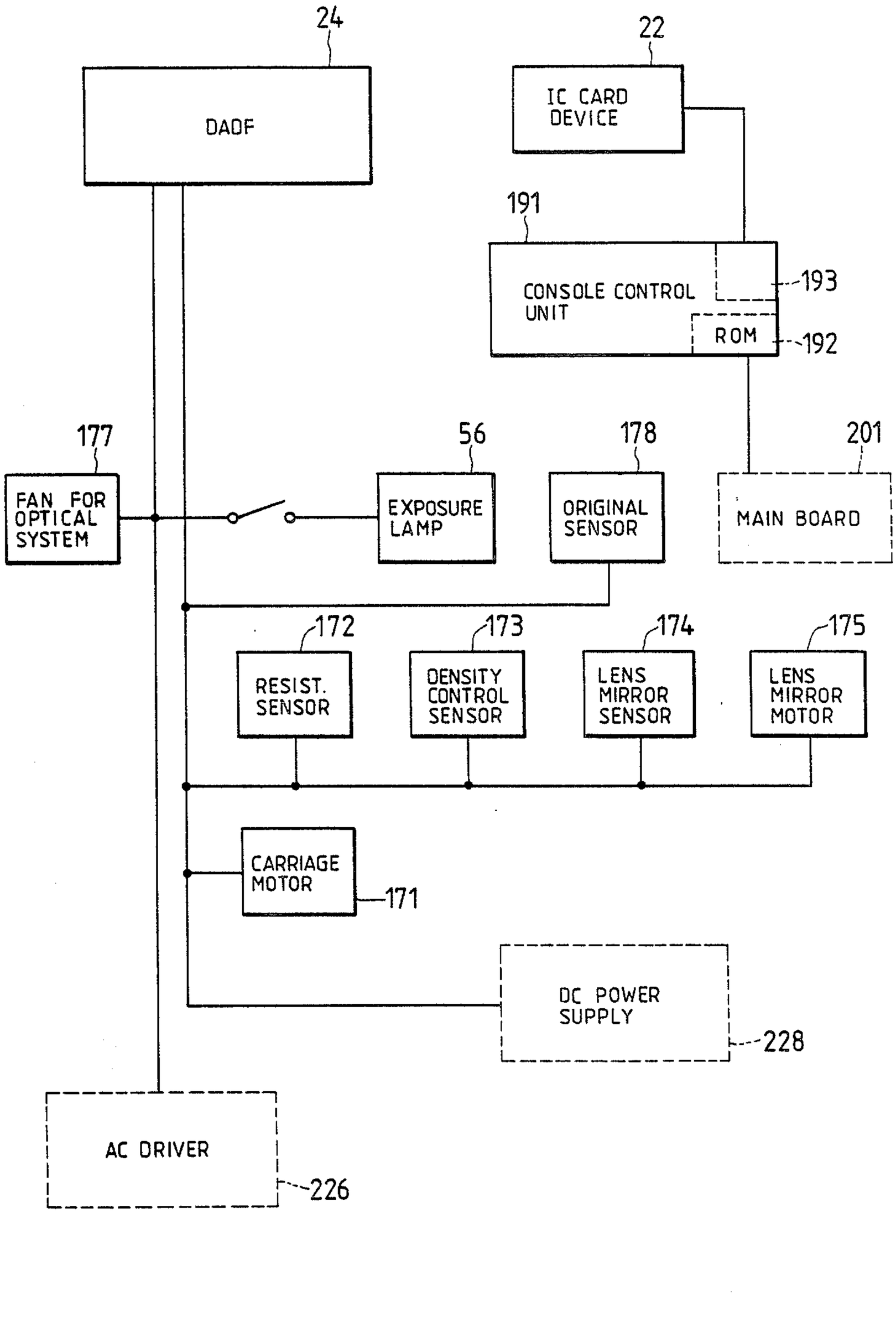

24
DAOF
22
IC CARD DEVICE
191
CONSOLE CONTROL UNIT
193
ROM
192
177
FAN FOR OPTICAL SYSTEM
56
EXPOSURE LAMP
178
ORIGINAL SENSOR
201
MAIN BOARD
172
RESIST. SENSOR
173
DENSITY CONTROL SENSOR
174
LENS MIRROR SENSOR
175
LENS MIRROR MOTOR
CARRIAGE MOTOR
171
DC POWER SUPPLY
228
AC DRIVER
226

FIG. 12

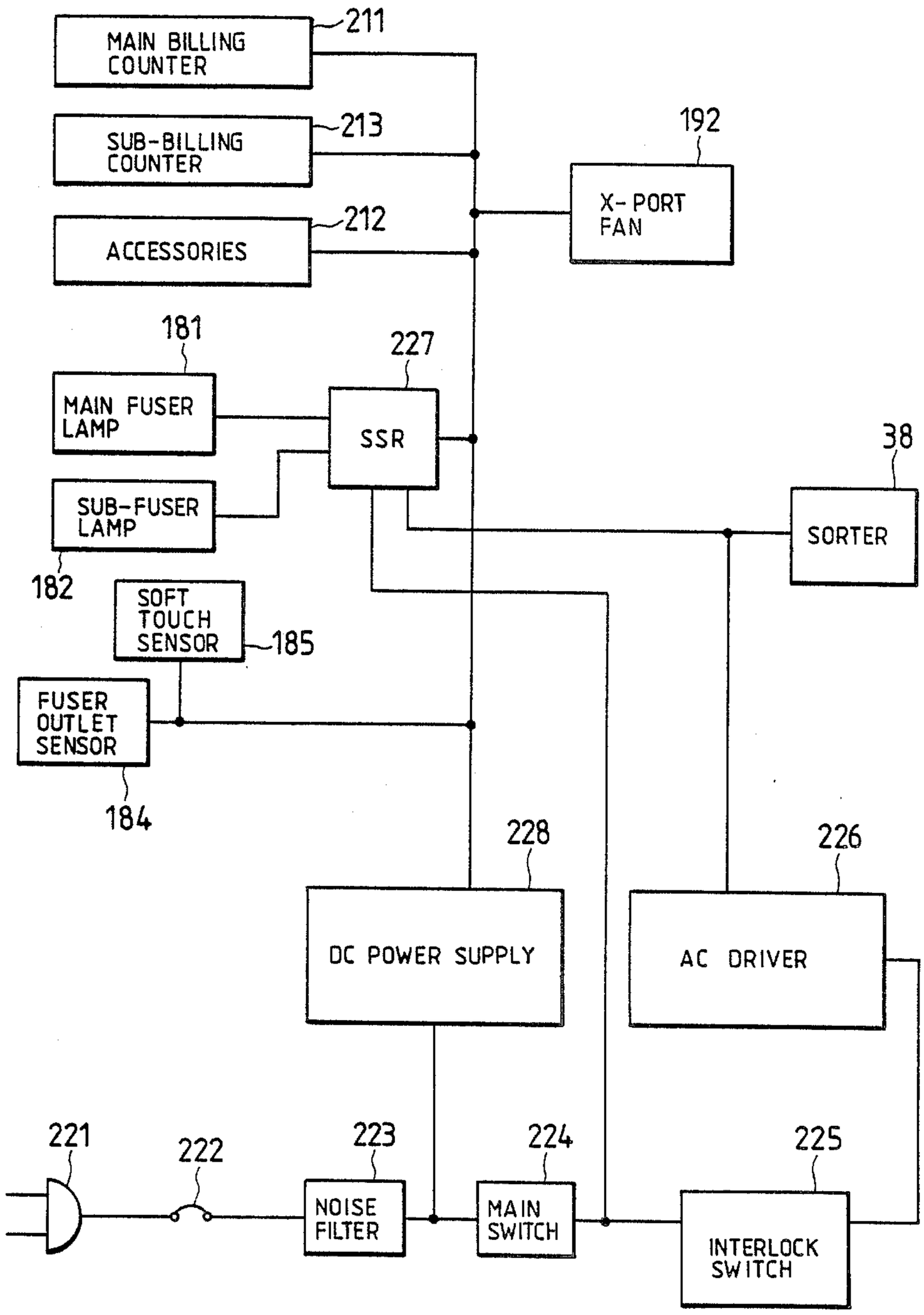

MAIN BILLING COUNTER
211
SUB-BILLING COUNTER
213
ACCESSORIES
212
192
X-PORT FAN
181
MAIN FUSER LAMP
227
SSR
SUB-FUSER LAMP
182
38
SORTER
SOFT TOUCH SENSOR
185
FUSER OUTLET SENSOR
184
228
DC POWER SUPPLY
226
AC DRIVER
221
222
223
NOISE FILTER
224
MAIN SWITCH
225
INTERLOCK SWITCH

FIG. 13

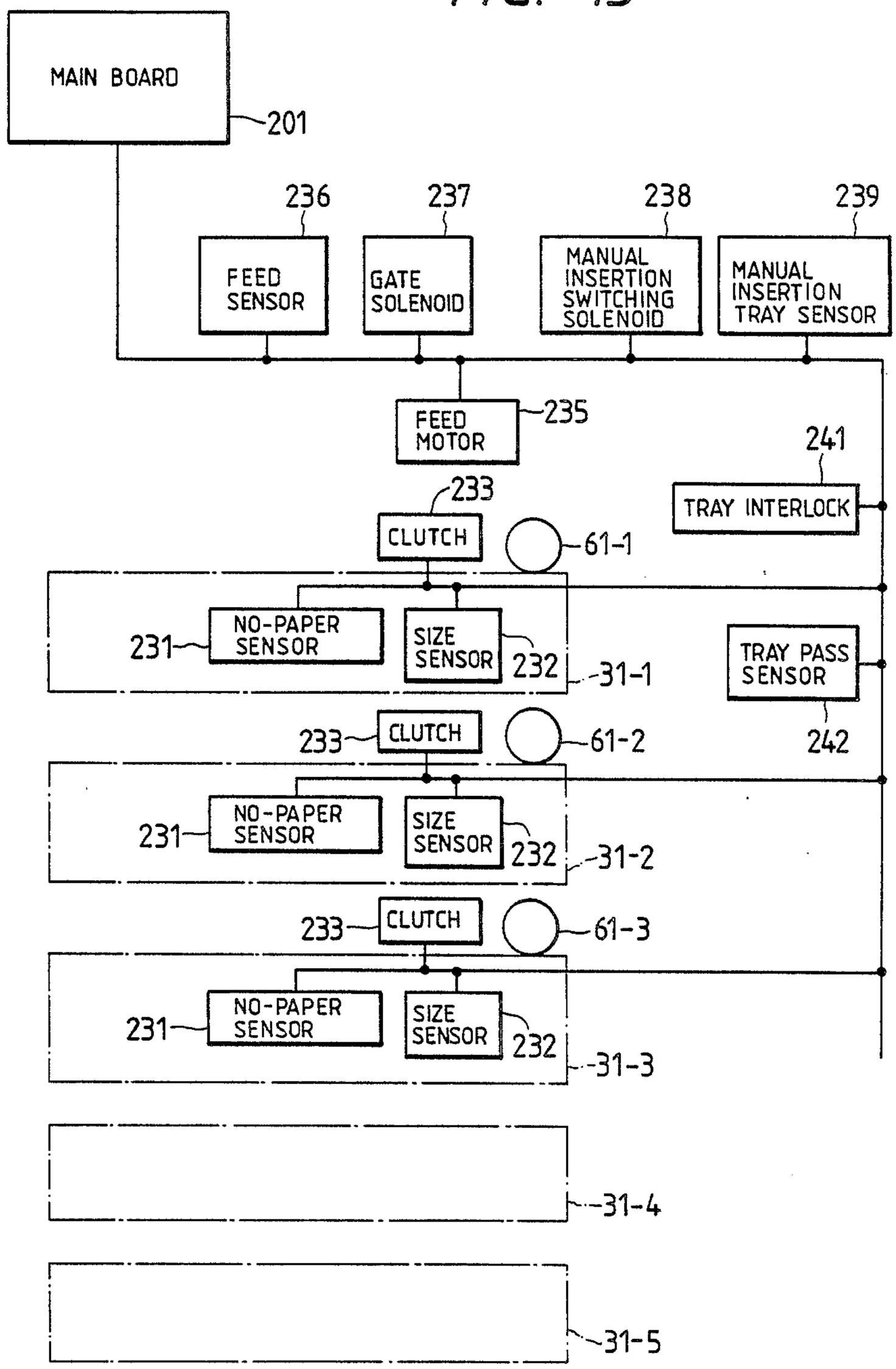

MAIN BOARD
201
236
FEED SENSOR
237
GATE SOLENOID
238
MANUAL INSERTION SWITCHING SOLENOID
239
MANUAL INSERTION TRAY SENSOR
FEED MOTOR
235
241
TRAY INTERLOCK
233
CLUTCH
61-1
231
NO-PAPER SENSOR
SIZE SENSOR
232
31-1
TRAY PASS SENSOR
242
233
CLUTCH
61-2
231
NO-PAPER SENSOR
SIZE SENSOR
232
31-2
233
CLUTCH
61-3
231
NO-PAPER SENSOR
SIZE SENSOR
232
31-3
31-4
31-5

FIG. 14

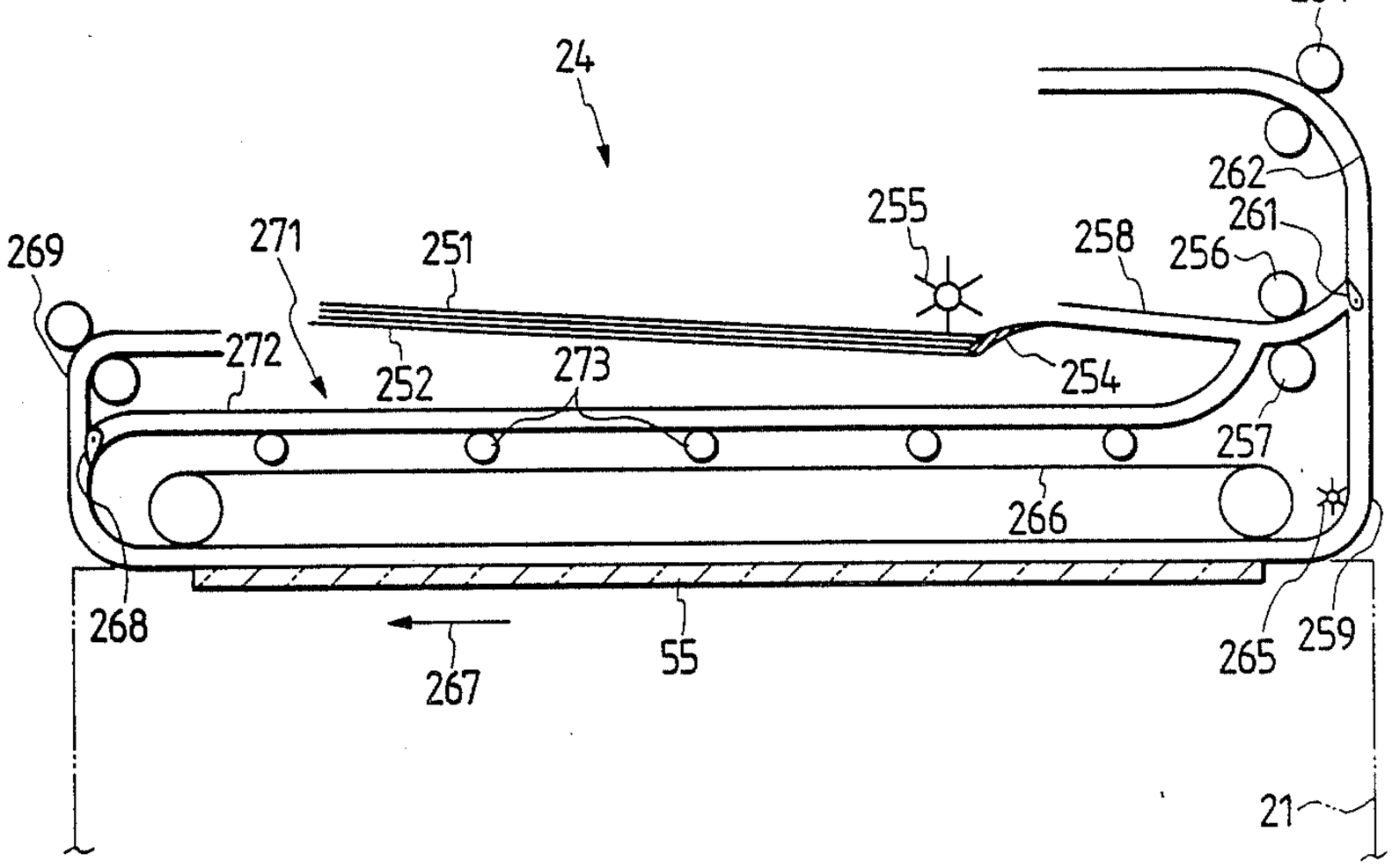

24
264
262
261
255
258
256
269
271
251
272
252
273
254
257
266
268
267
55
265
259
21

FIG. 15

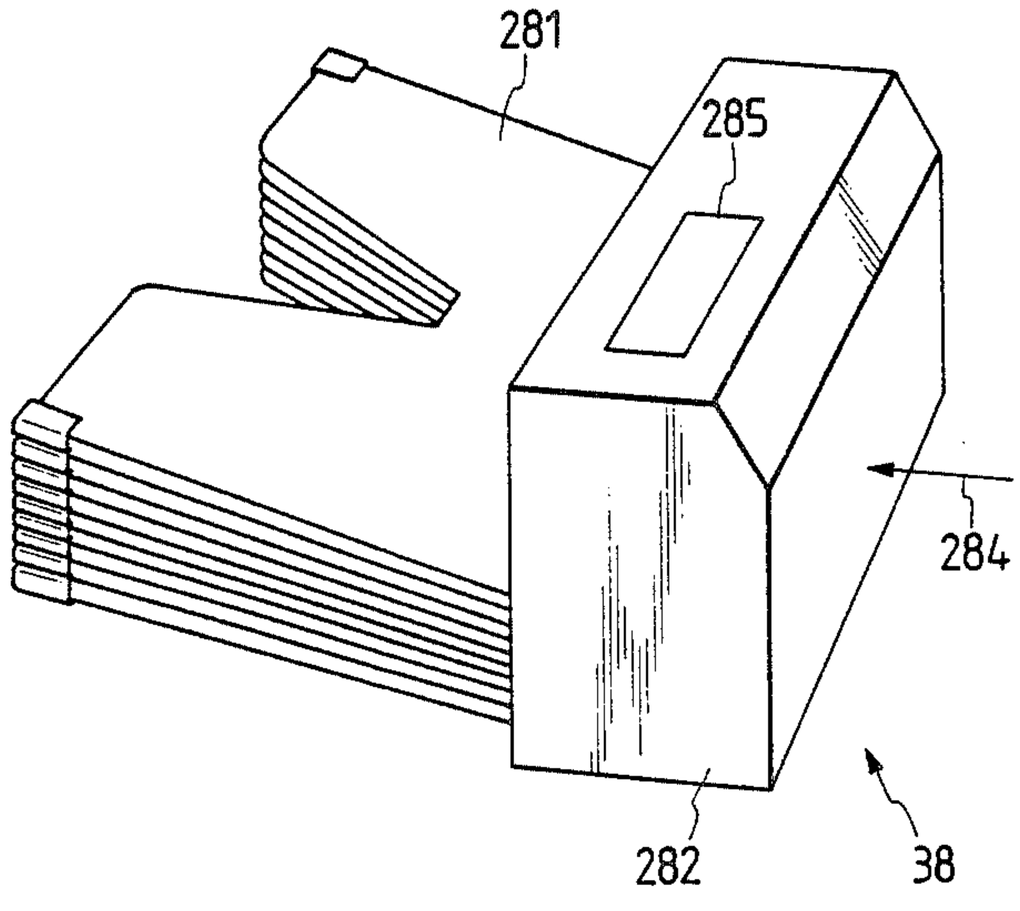

281
285
284
282
38

FIG. 16

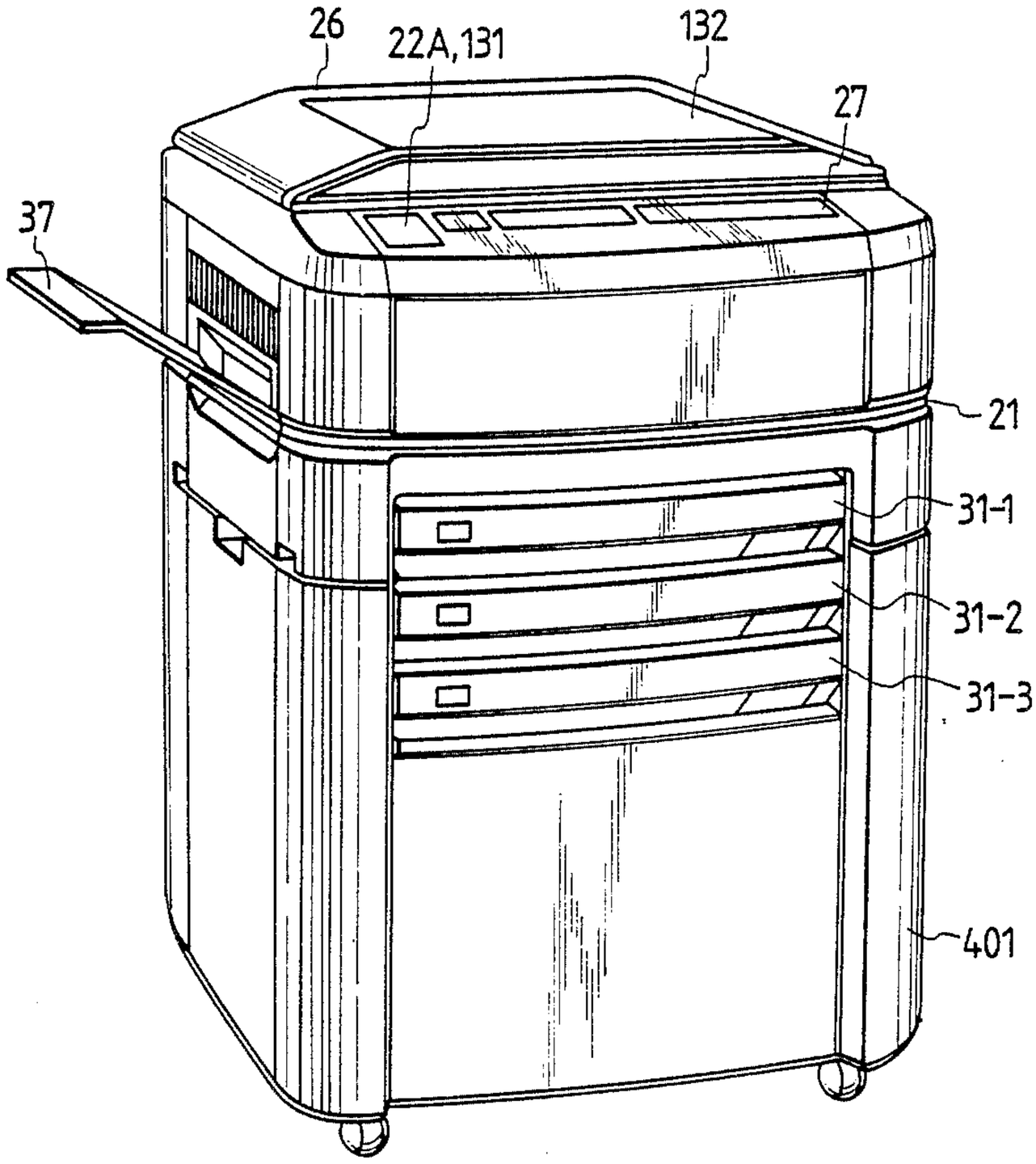


FIG. 17

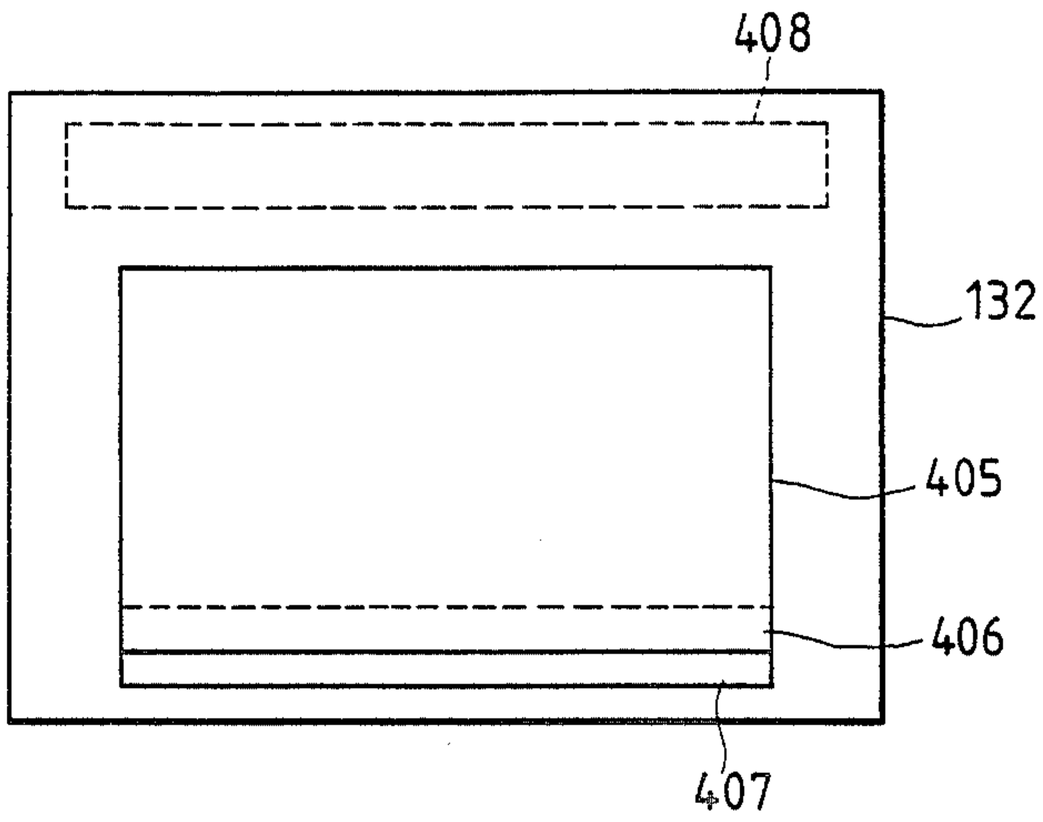

408
132
405
406
407

FIG. 20

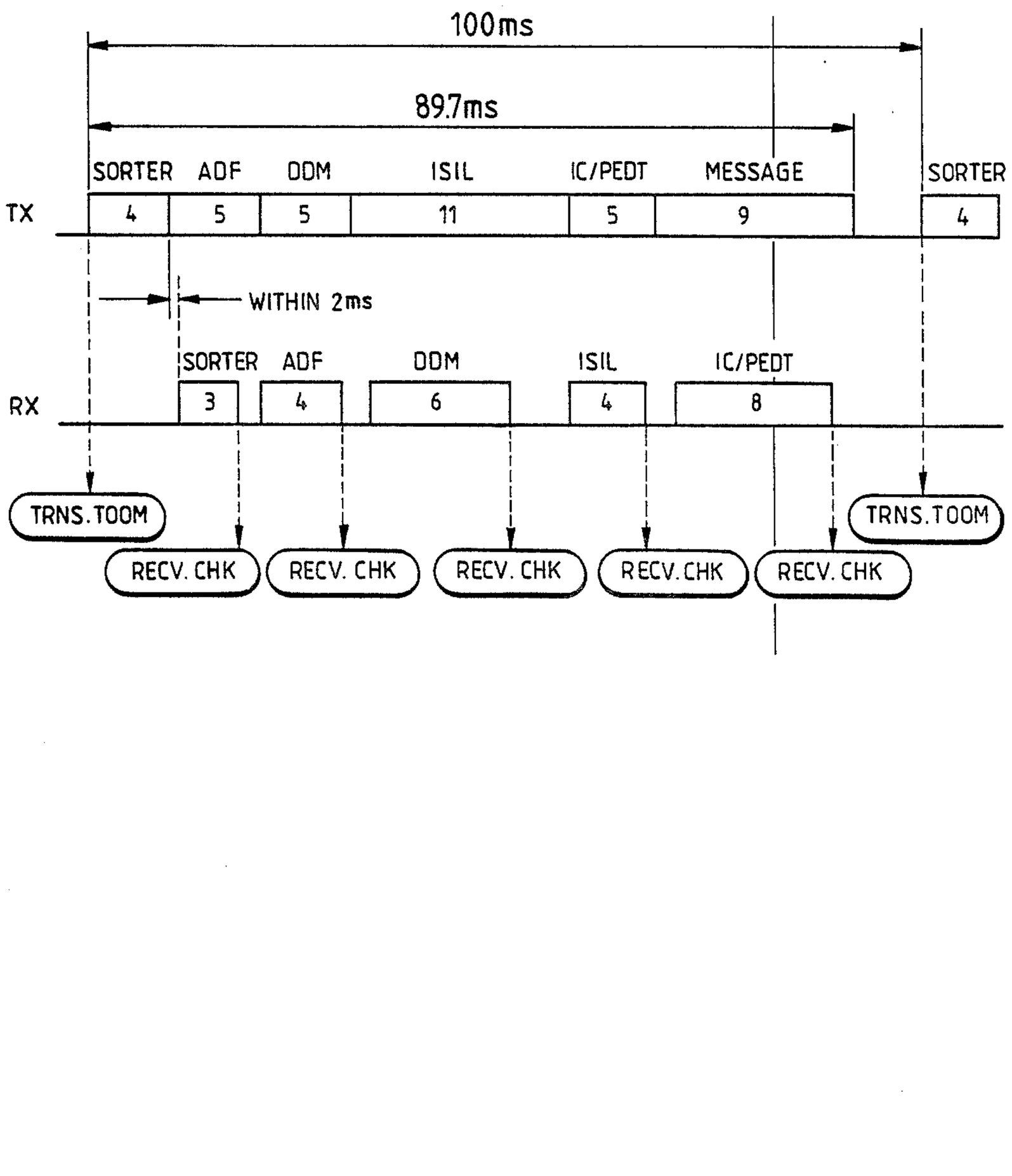

100ms
89.7ms
SORTER
ADF
DDM
ISIL
IC/PEDT
MESSAGE
SORTER
TX
4
5
5
11
5
9
4
WITHIN 2ms
SORTER
ADF
DDM
ISIL
IC/PEDT
RX
3
4
6
4
8
TRNS.TOOM
TRNS.TOOM
RECV. CHK
RECV. CHK
RECV. CHK
RECV. CHK
RECV. CHK

FIG. 18

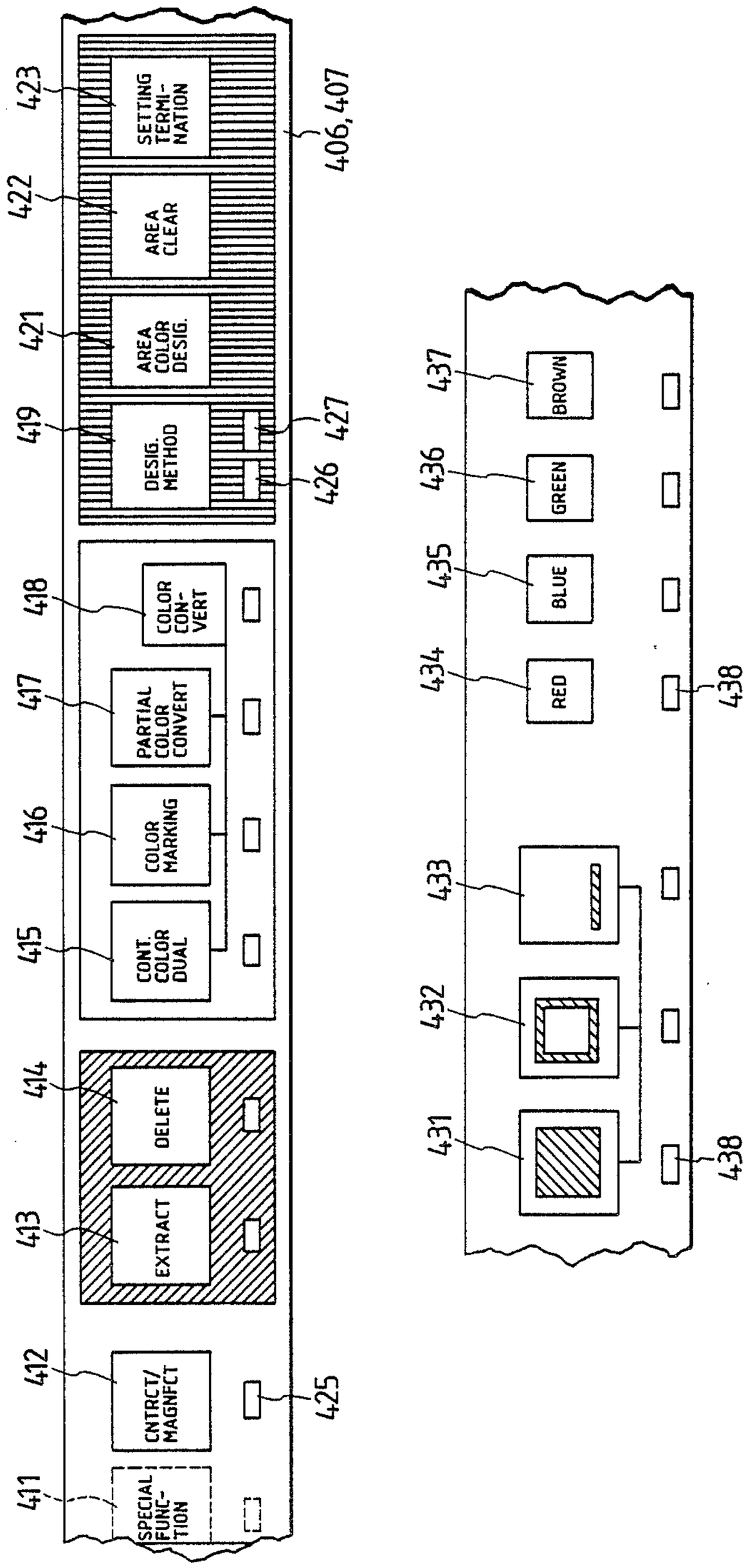

SETTING TERMI-NATION
AREA CLEAR
AREA COLOR DESIG.
DESIG. METHOD
COLOR CON-VERT
PARTIAL COLOR CONVERT
COLOR MARKING
CONT. COLOR DUAL
DELETE
EXTRACT
CNTRCT/ MAGNFCT
SPECIAL FUNC-TION
BROWN
GREEN
BLUE
RED
423
422
421
419
418
417
416
415
414
413
412
411
406,407
427
426
425
437
436
435
434
433
432
431
438

FIG. 19

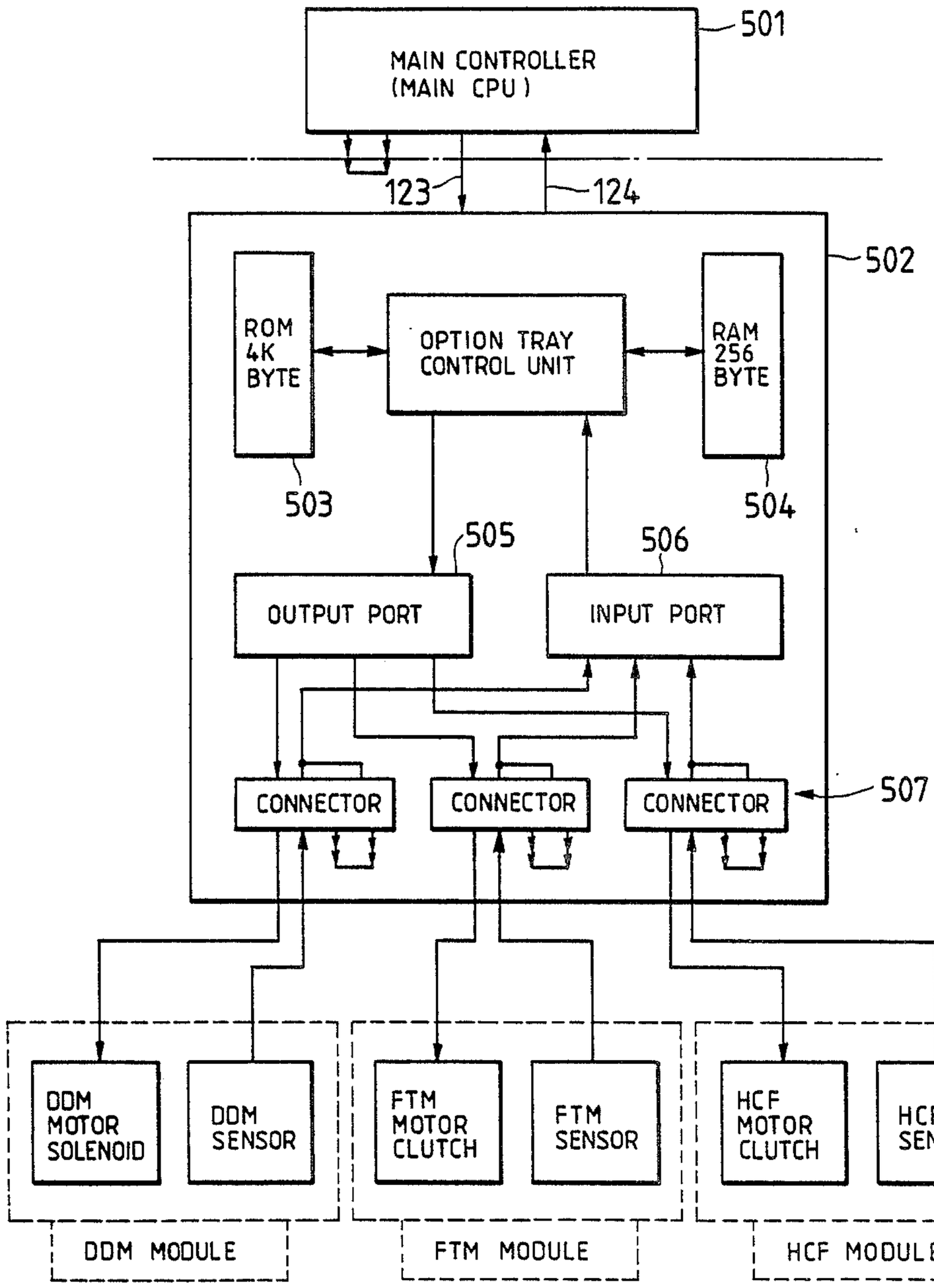

MAIN CONTROLLER
(MAIN CPU)
501
123
124
502
ROM
4K
BYTE
OPTION TRAY
CONTROL UNIT
RAM
256
BYTE
503
504
505
506
OUTPUT PORT
INPUT PORT
CONNECTOR
CONNECTOR
CONNECTOR
507
DDM
MOTOR
SOLENOID
DDM
SENSOR
FTM
MOTOR
CLUTCH
FTM
SENSOR
HCF
MOTOR
CLUTCH
HCF
SENSOR
DDM MODULE
FTM MODULE
HCF MODULE

FIG. 21(a)

CONTROL WORD
SERL #IN1
SERL #IN2
SERL #IN3
BCC

FIG. 21(b)

CONTROL WORD
SERL #OUT 1
SERL #OUT 2
SERL #OUT 3
SERL #OUT 4
BCC

FIG. 22(a)

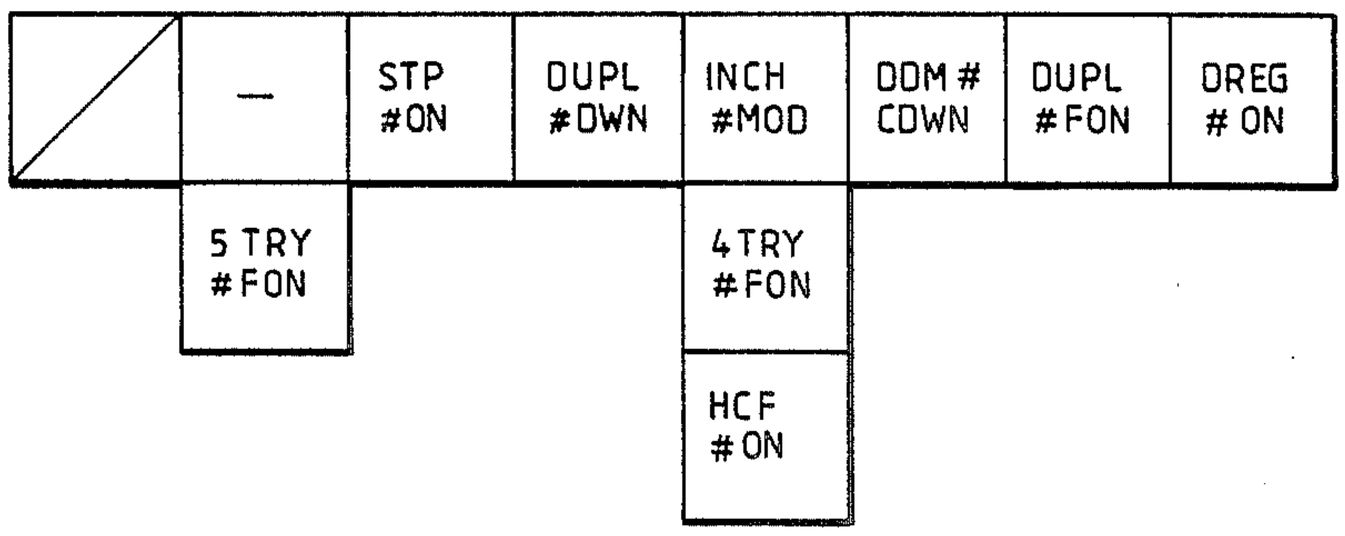


FIG. 22(b)

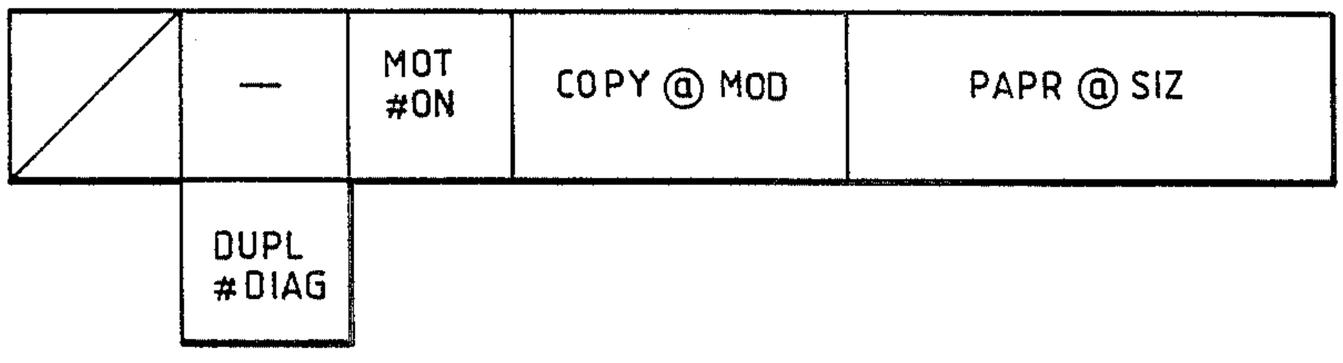


FIG. 22(c)

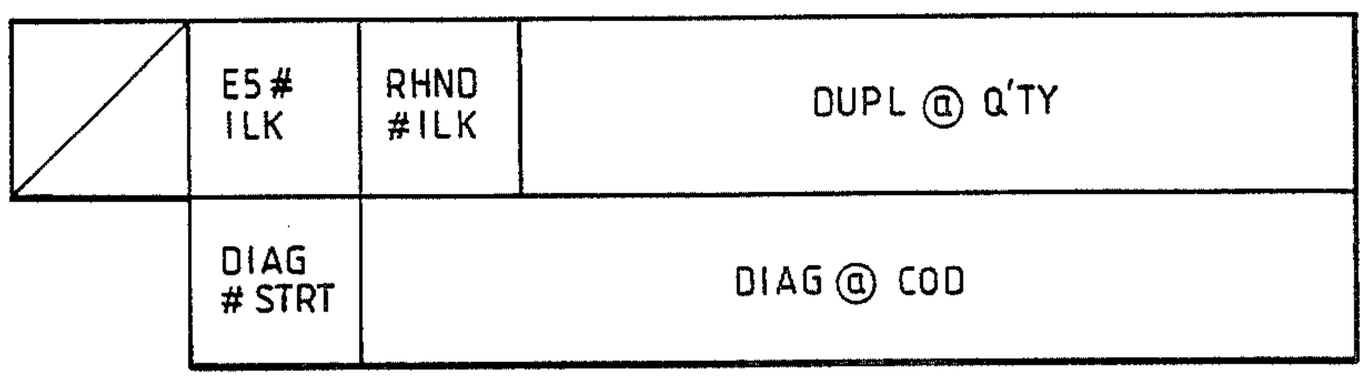


FIG. 23(a)

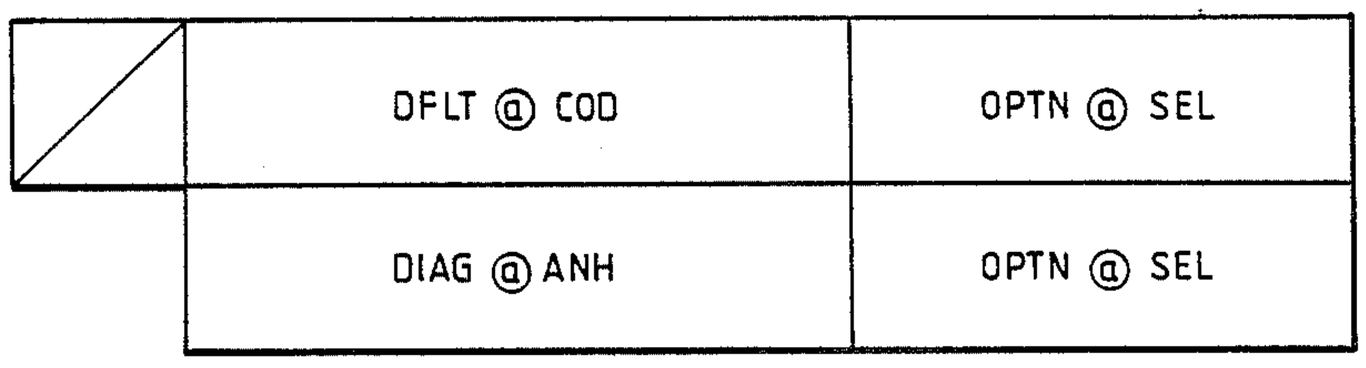


FIG. 23(b)

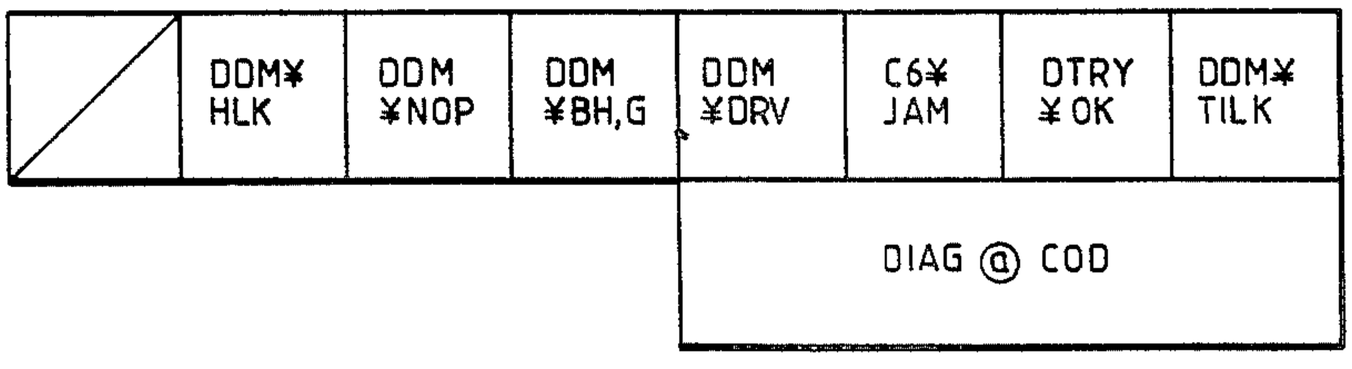


FIG. 23(c)

	DFH ¥JAM	C7¥ JAM	—	HCF @ SIZ
	DFH ¥JAM	C4¥ JAM	C5¥ JAM	4TRY @ SIZ
	DFM ¥JAM			

FIG. 23(d)

	HCFV NOP	HCF ¥ILK	HCF¥ RDY	ELEV @ FLT
	—			5 TRY @ SIZ
	HCF¥ DIAG			

FIG. 24

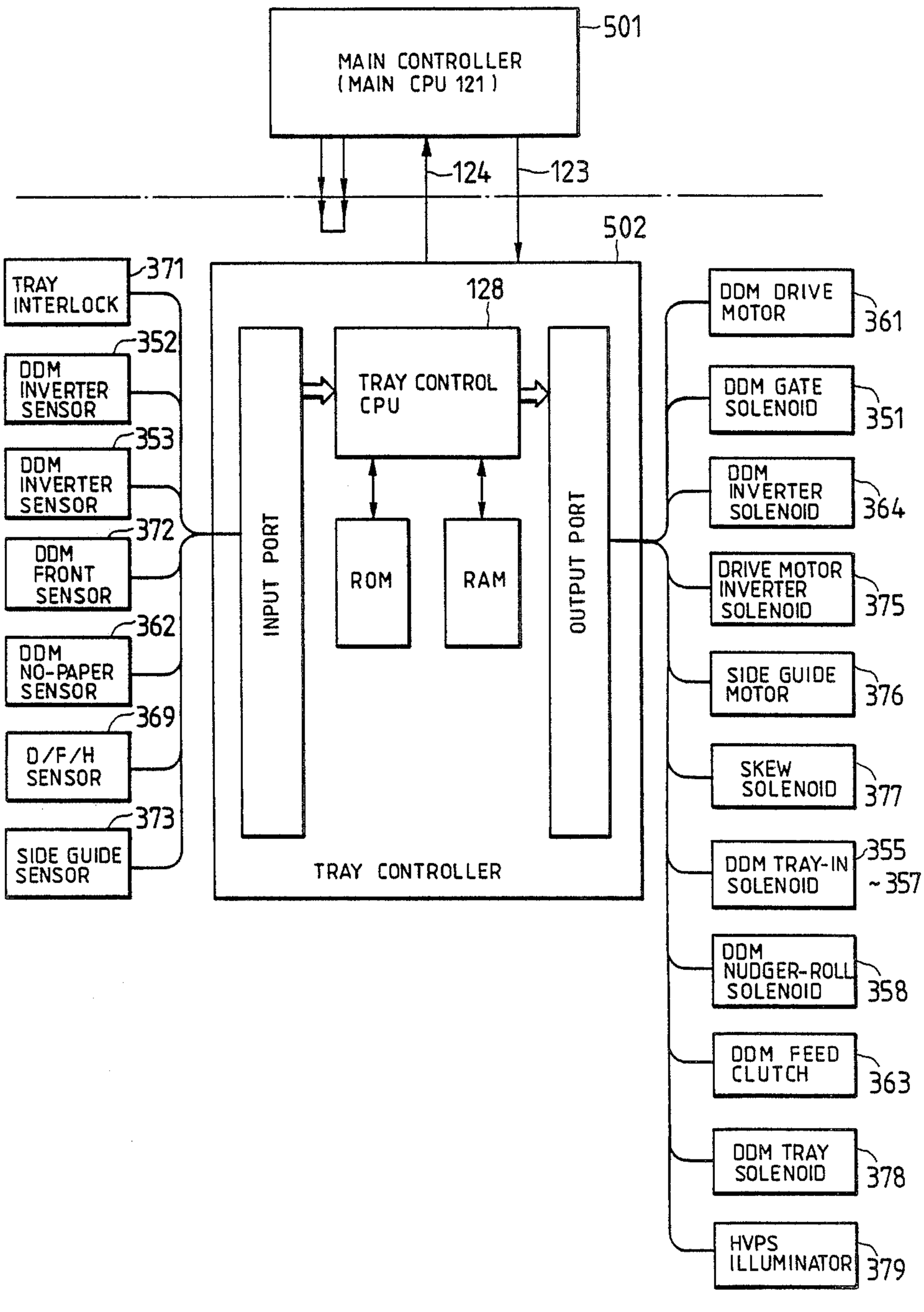

MAIN CONTROLLER
(MAIN CPU 121)
501
124
123
502
128
TRAY INTERLOCK
371
DDM INVERTER SENSOR
352
DDM INVERTER SENSOR
353
DDM FRONT SENSOR
372
DDM NO-PAPER SENSOR
362
D/F/H SENSOR
369
SIDE GUIDE SENSOR
373
INPUT PORT
TRAY CONTROL CPU
ROM
RAM
OUTPUT PORT
TRAY CONTROLLER
DDM DRIVE MOTOR
361
DDM GATE SOLENOID
351
DDM INVERTER SOLENOID
364
DRIVE MOTOR INVERTER SOLENOID
375
SIDE GUIDE MOTOR
376
SKEW SOLENOID
377
DDM TRAY-IN SOLENOID
355 ~ 357
DDM NUDGER-ROLL SOLENOID
358
DDM FEED CLUTCH
363
DDM TRAY SOLENOID
378
HVPS ILLUMINATOR
379

FIG. 25

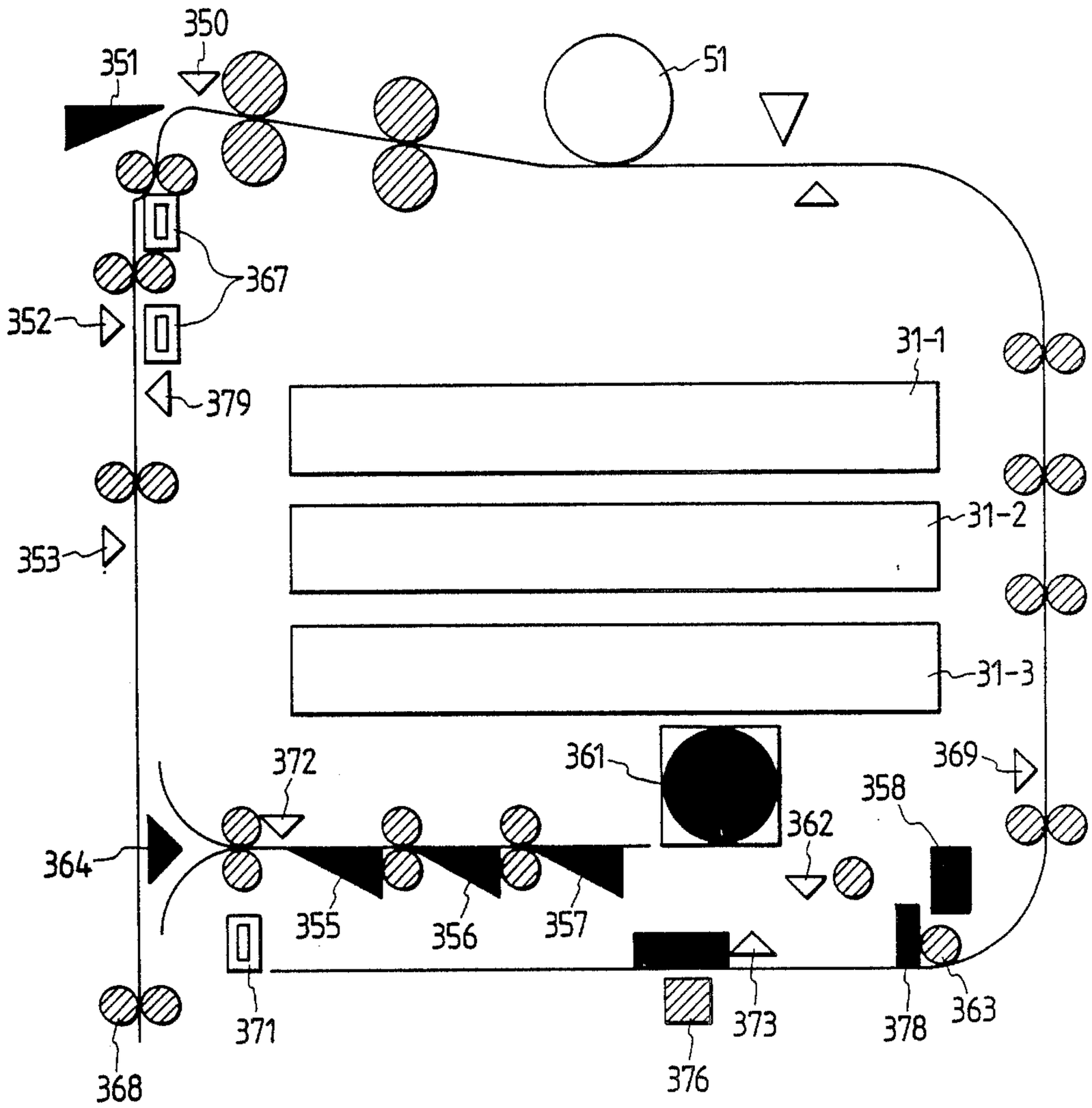

350
351
51
367
352
379
31-1
353
31-2
31-3
372
361
369
358
364
362
355
356
357
371
373
378
363
376
368

FIG. 26

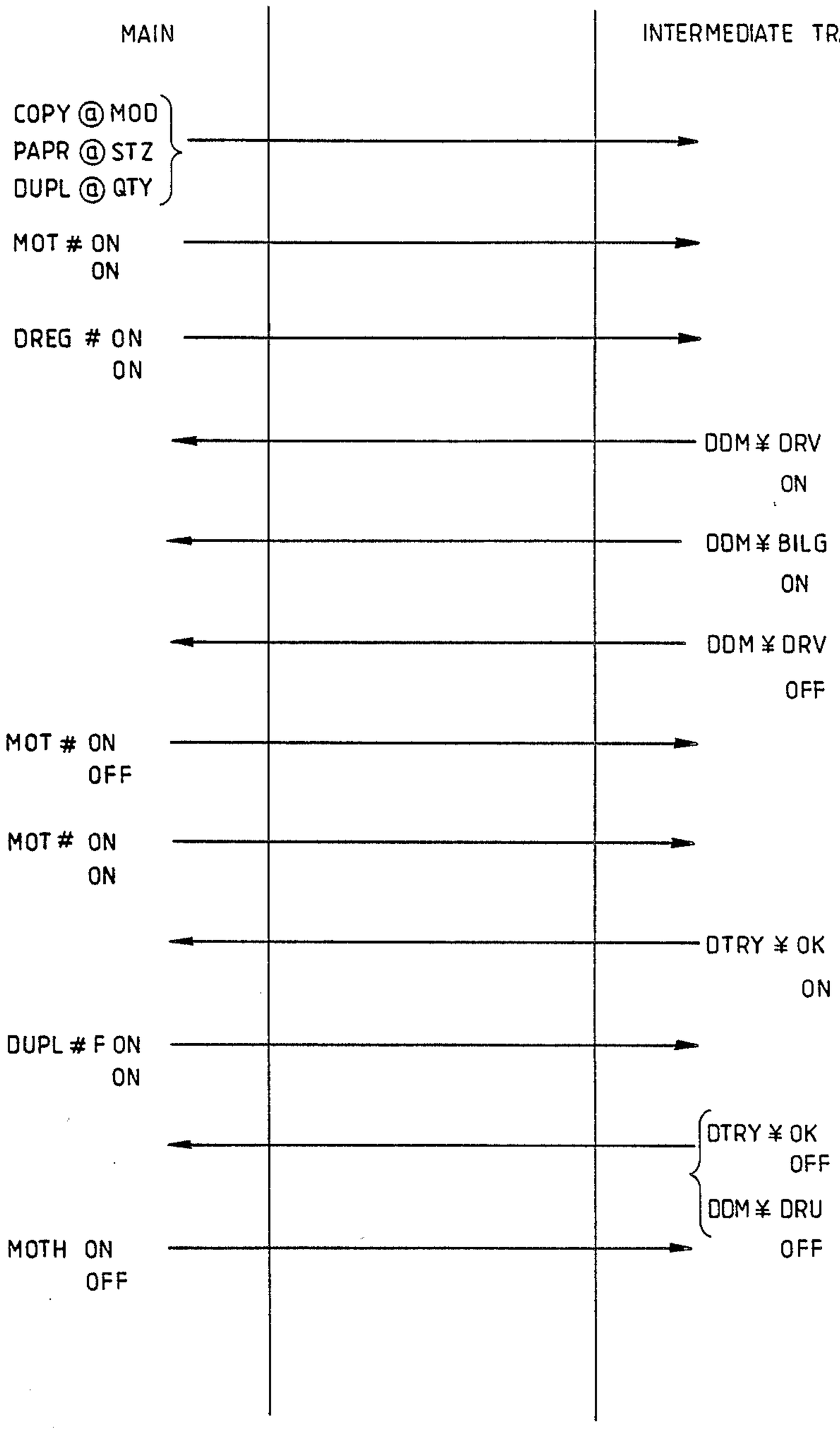

MAIN
INTERMEDIATE TRAY
COPY @ MOD
PAPR @ STZ
DUPL @ QTY
MOT # ON
ON
DREG # ON
ON
DDM ¥ DRV
ON
DDM ¥ BILG
ON
DDM ¥ DRV
OFF
MOT # ON
OFF
MOT # ON
ON
DTRY ¥ OK
ON
DUPL # F ON
ON
DTRY ¥ OK
OFF
DDM ¥ DRU
OFF
MOTH ON
OFF

FIG. 27

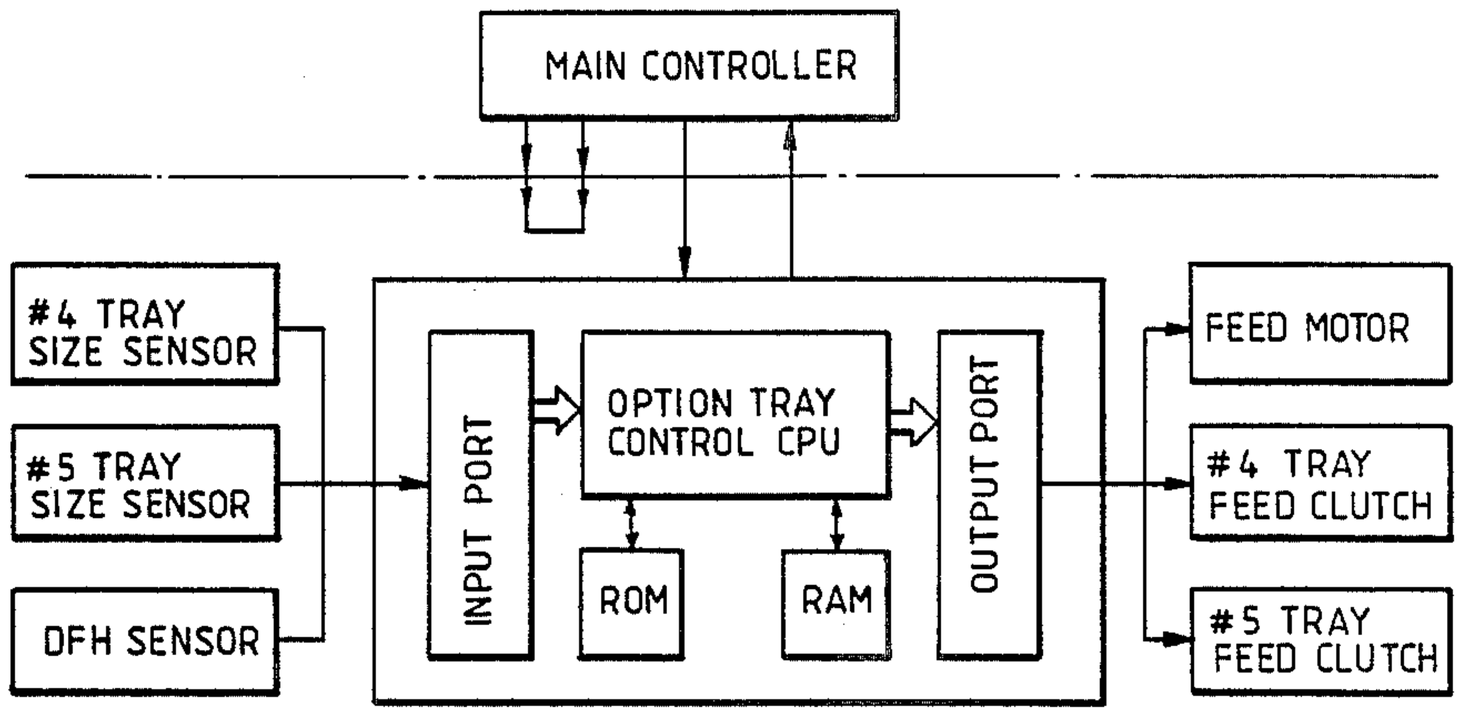
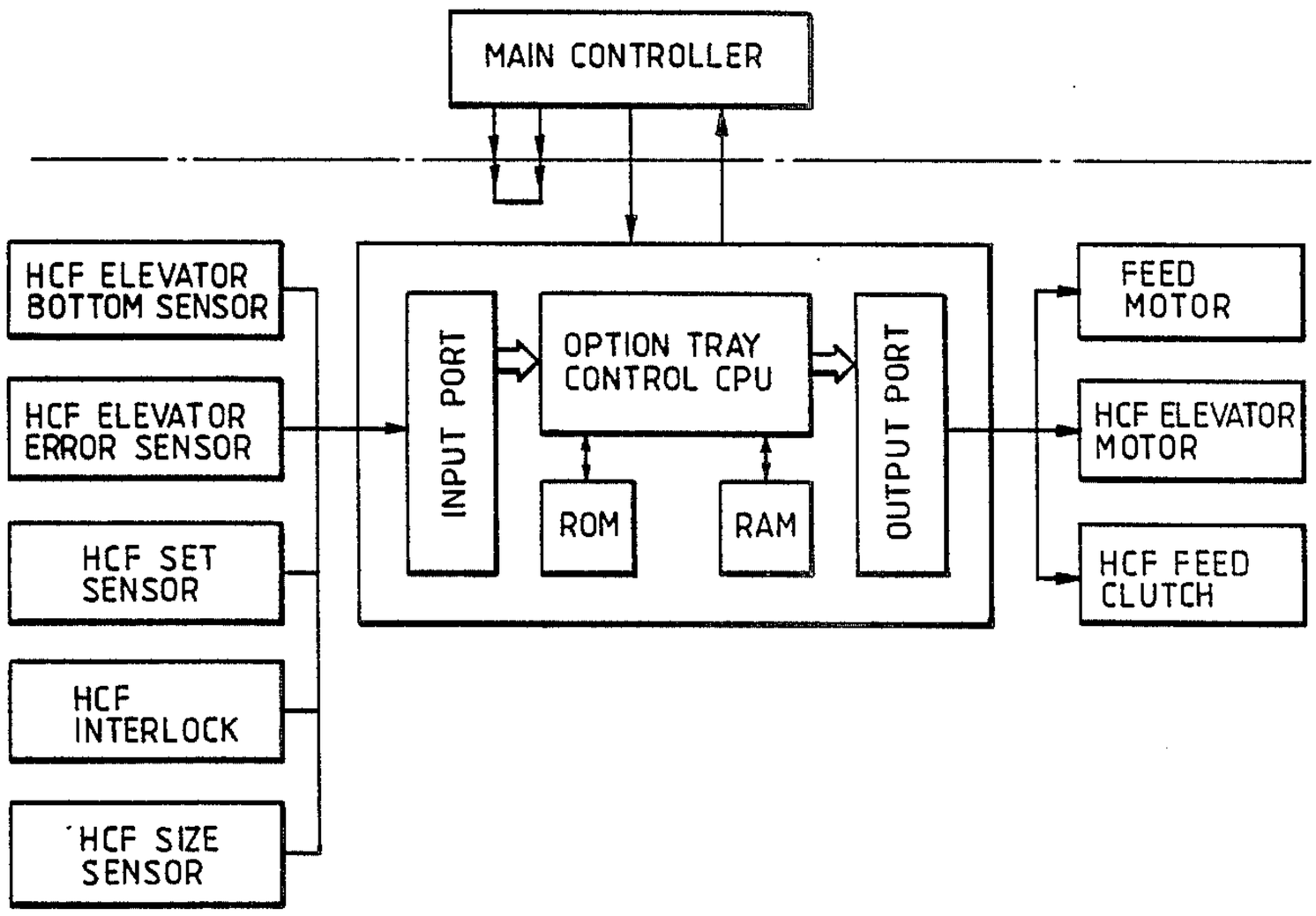

MAIN CONTROLLER
#4 TRAY SIZE SENSOR
#5 TRAY SIZE SENSOR
DFH SENSOR
INPUT PORT
OPTION TRAY CONTROL CPU
ROM
RAM
OUTPUT PORT
FEED MOTOR
#4 TRAY FEED CLUTCH
#5 TRAY FEED CLUTCH

FIG. 28


MAIN CONTROLLER
HCF ELEVATOR BOTTOM SENSOR
HCF ELEVATOR ERROR SENSOR
HCF SET SENSOR
HCF INTERLOCK
HCF SIZE SENSOR
INPUT PORT
OPTION TRAY CONTROL CPU
ROM
RAM
OUTPUT PORT
FEED MOTOR
HCF ELEVATOR MOTOR
HCF FEED CLUTCH

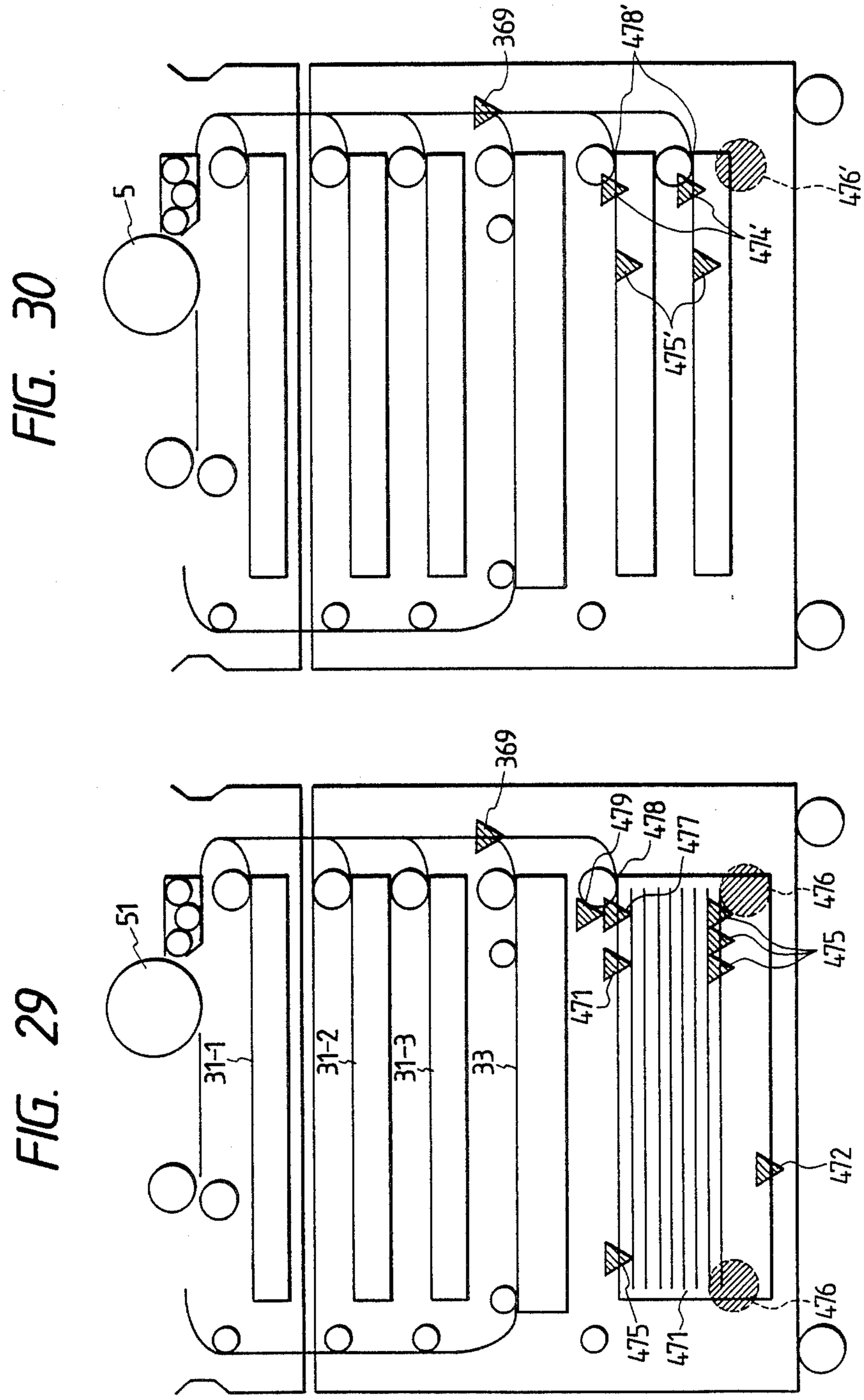

30
5
369
478'
476'
474'
475'
369
51
31-1
31-2
31-3
33
479
478
477
476
475
471
472

FIG. 30

FIG. 29

FIG. 31

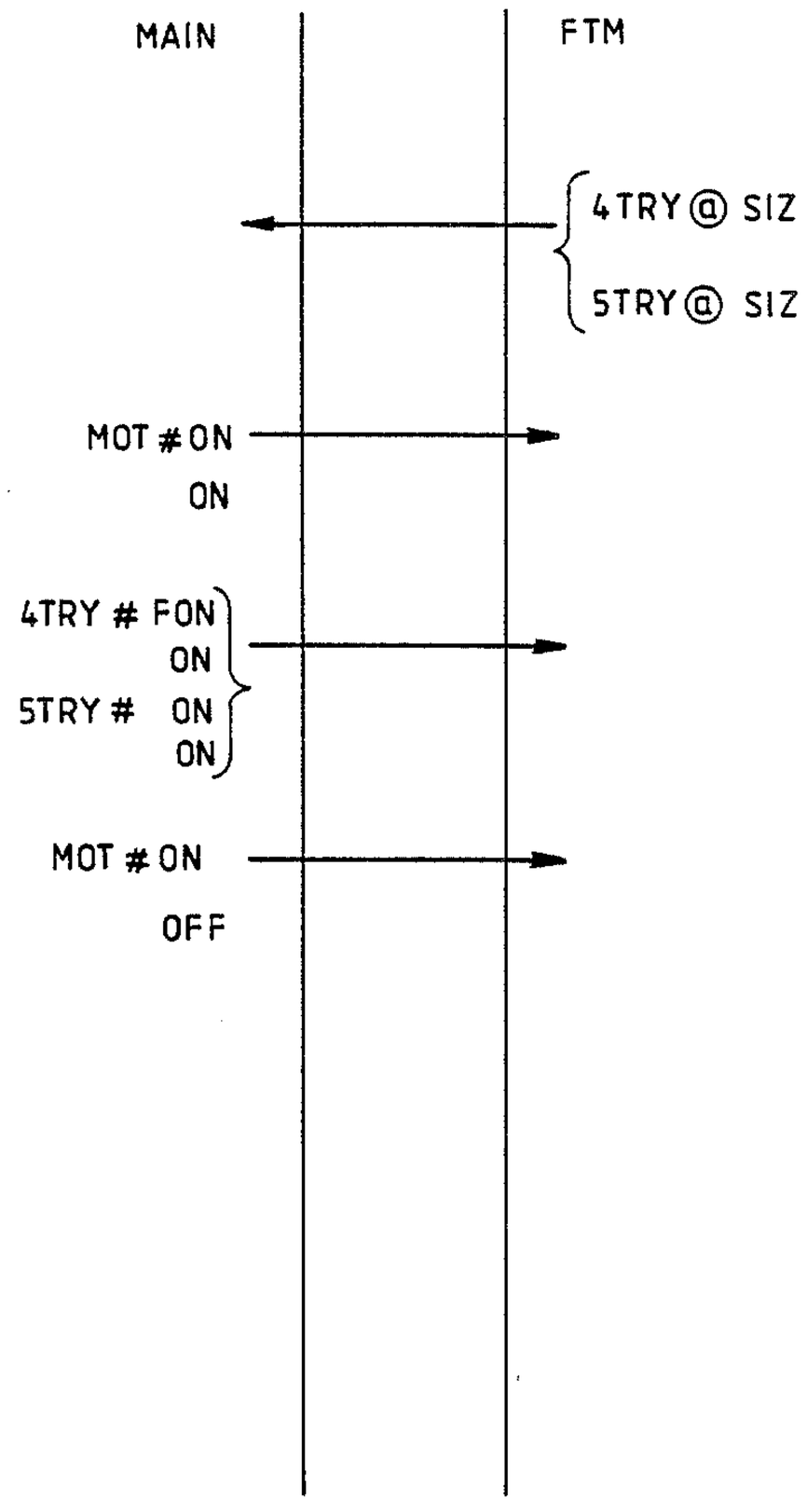

MAIN
FTM
4TRY @ SIZ
5TRY @ SIZ
MOT # ON
ON
4TRY # FON
ON
5TRY # ON
ON
MOT # ON
OFF

FIG. 32

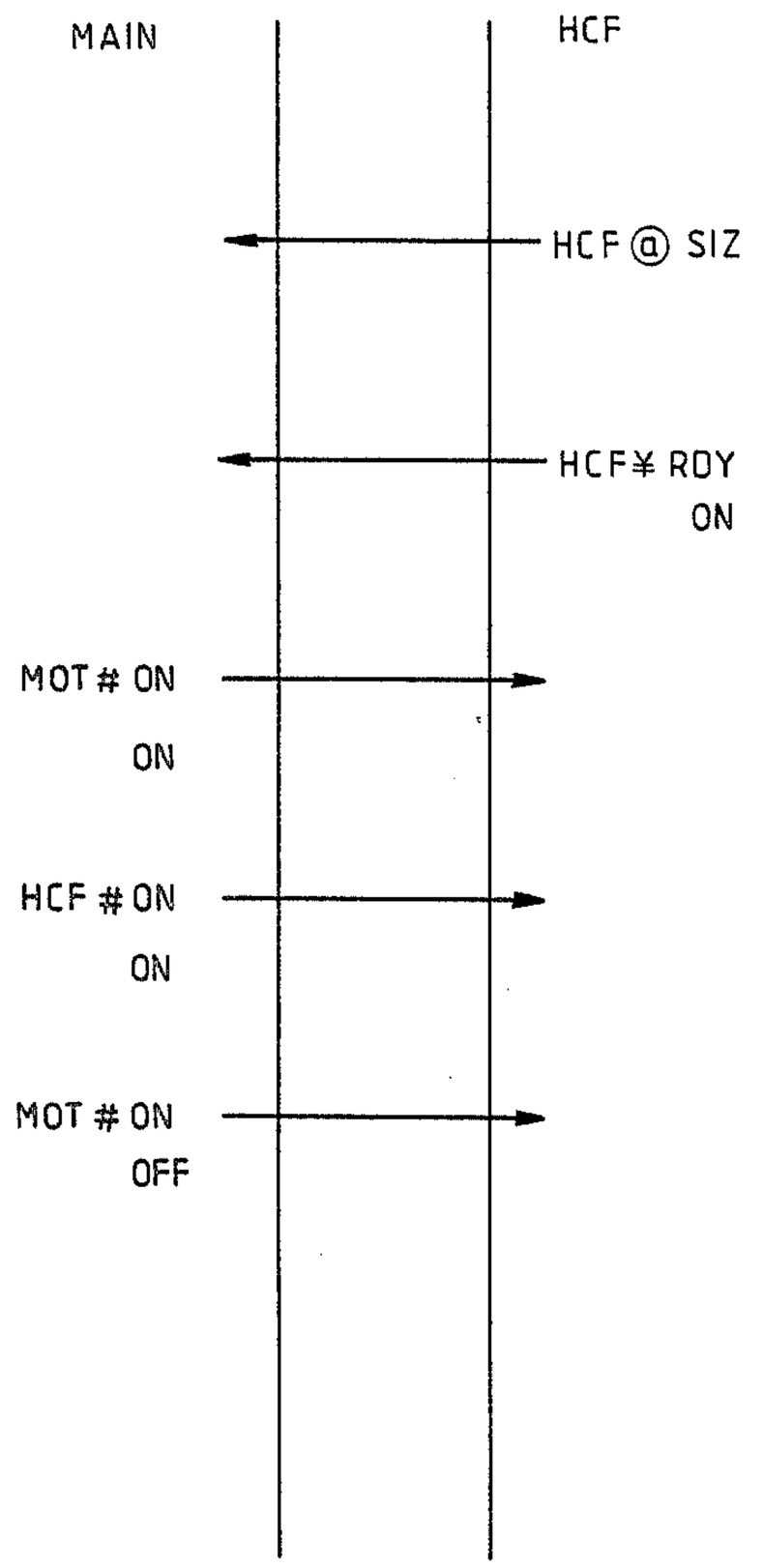

MAIN
HCF
HCF @ SIZ
HCF # RDY
ON
MOT # ON
ON
HCF # ON
ON
MOT # ON
OFF

FIG. 33

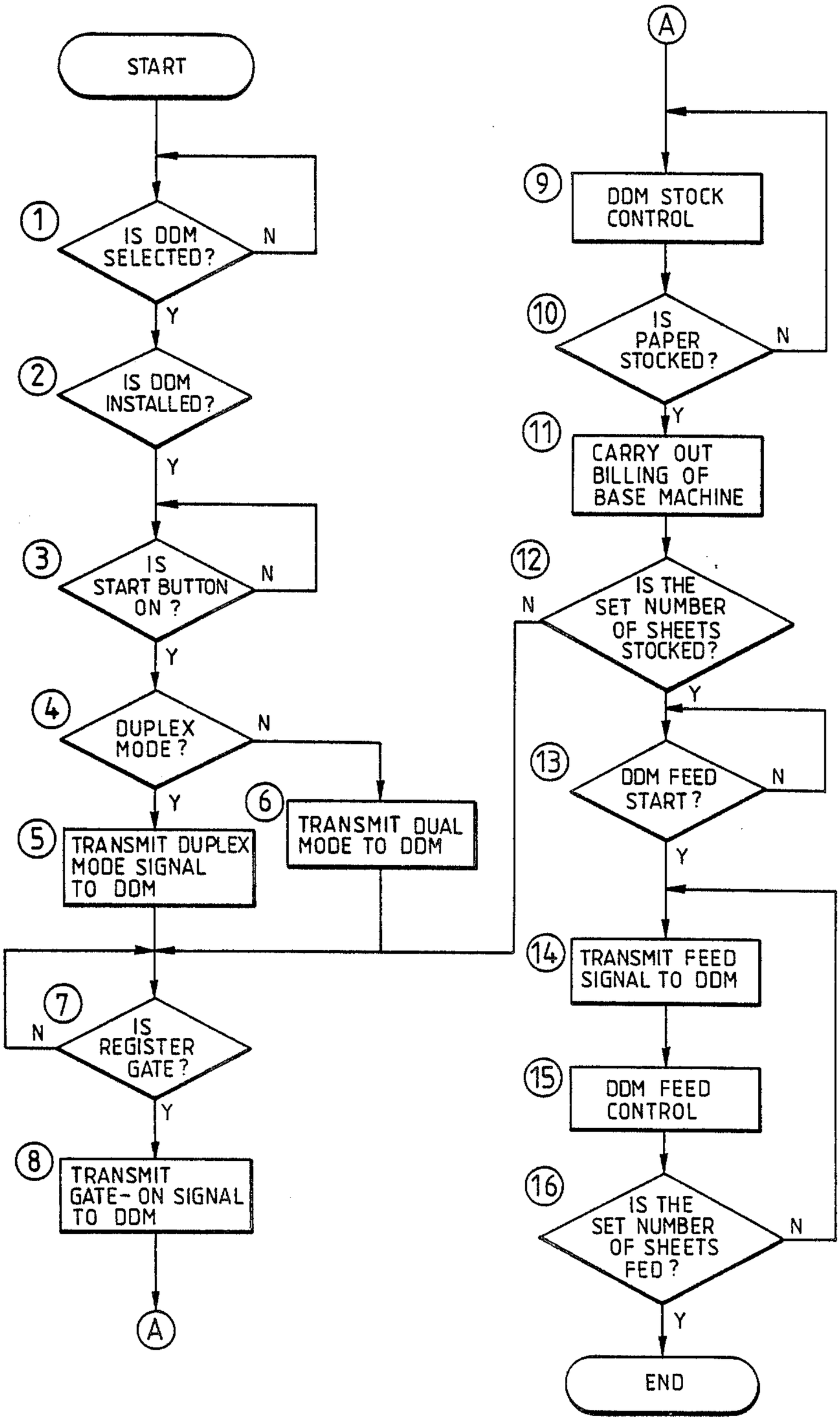

START
1
IS DDM SELECTED?
N
Y
2
IS DDM INSTALLED?
Y
3
IS START BUTTON ON ?
N
Y
4
DUPLEX MODE ?
N
Y
5
TRANSMIT DUPLEX MODE SIGNAL TO DDM
6
TRANSMIT DUAL MODE TO DDM
7
IS REGISTER GATE?
N
Y
8
TRANSMIT GATE-ON SIGNAL TO DDM
A
A
9
DDM STOCK CONTROL
10
IS PAPER STOCKED?
N
Y
11
CARRY OUT BILLING OF BASE MACHINE
12
IS THE SET NUMBER OF SHEETS STOCKED?
N
Y
13
DDM FEED START?
N
Y
14
TRANSMIT FEED SIGNAL TO DDM
15
DDM FEED CONTROL
16
IS THE SET NUMBER OF SHEETS FED?
N
Y
END

FIG. 35

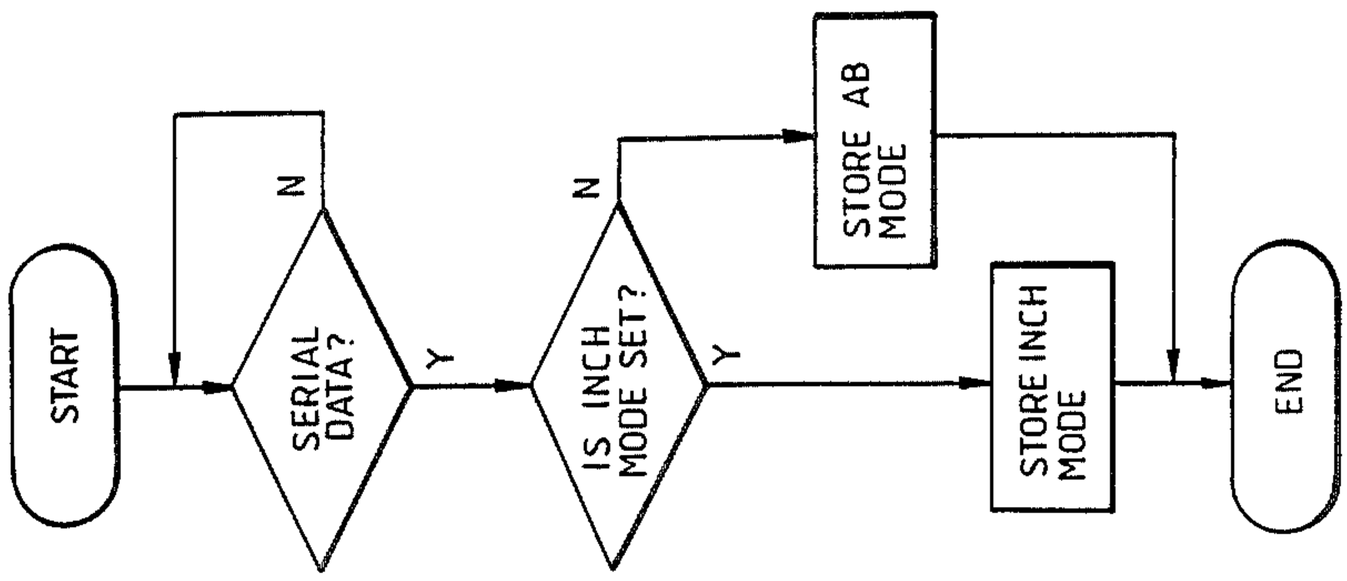

START
SERIAL DATA?
N
Y
IS INCH MODE SET?
N
Y
STORE AB MODE
STORE INCH MODE
END

FIG. 34

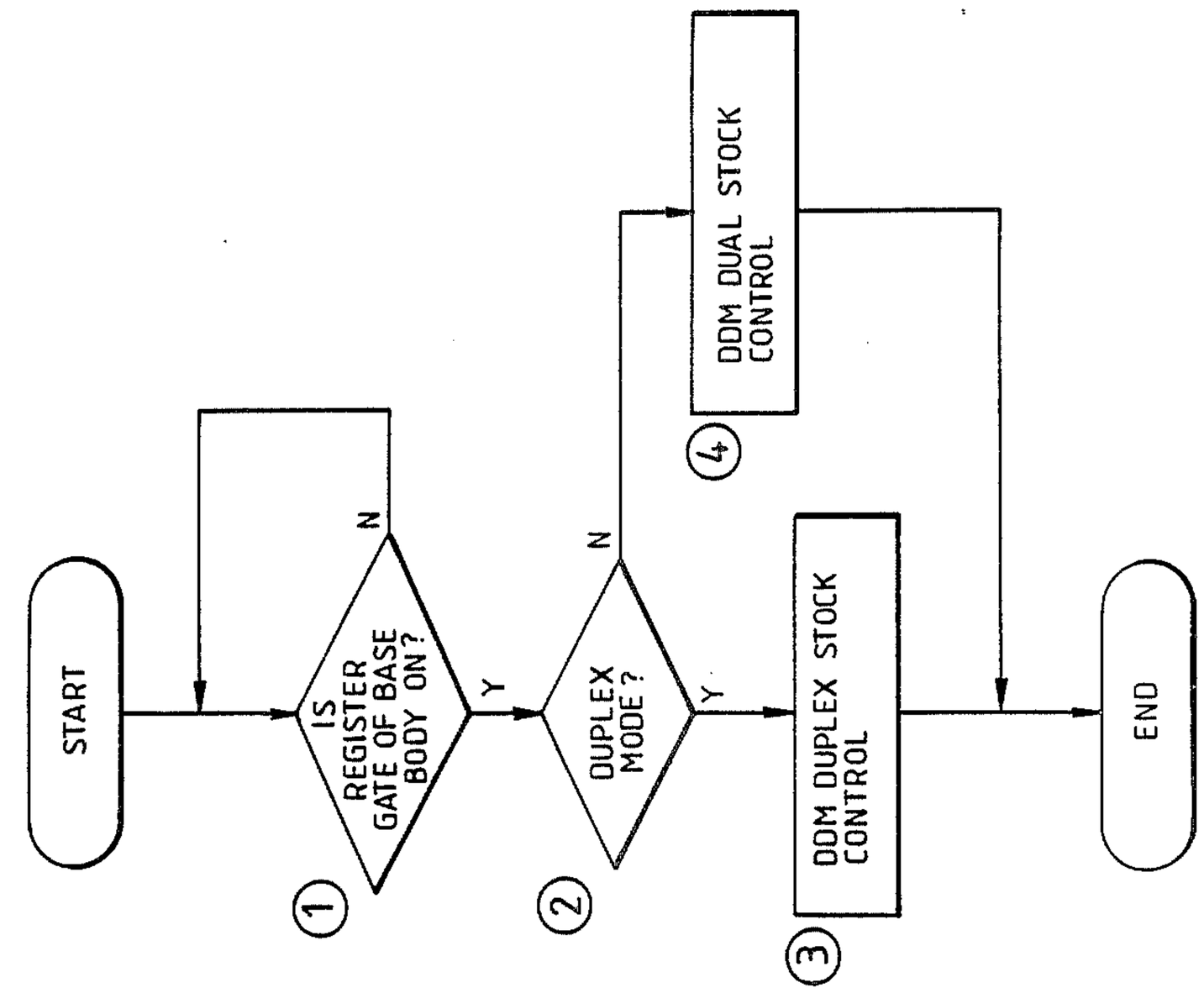

START
IS REGISTER GATE OF BASE BODY ON?
N
Y
1
DUPLEX MODE?
N
Y
2
DDM DUPLEX STOCK CONTROL
3
DDM DUAL STOCK CONTROL
4
END

FIG. 36(a)

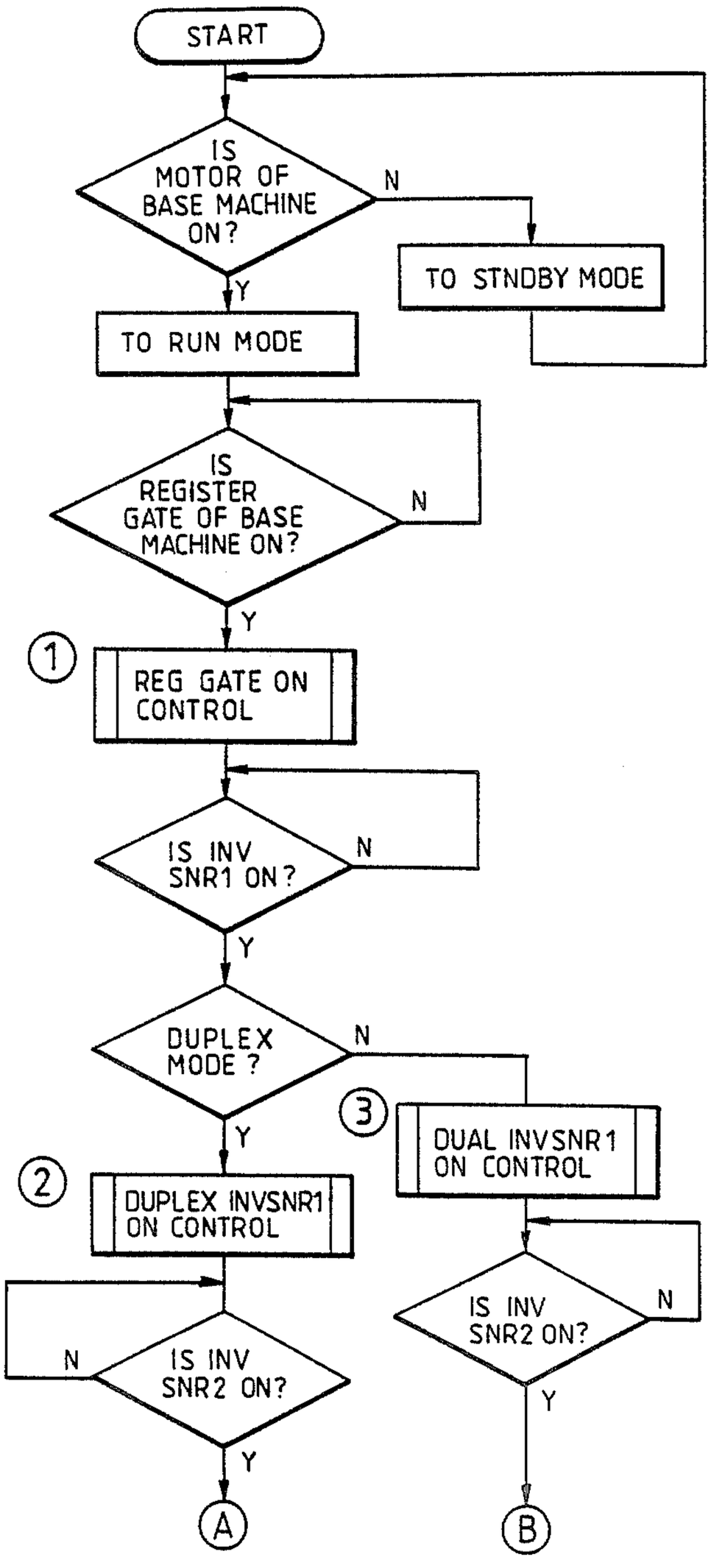

START
IS MOTOR OF BASE MACHINE ON?
N
TO STNDBY MODE
Y
TO RUN MODE
IS REGISTER GATE OF BASE MACHINE ON?
N
Y
1
REG GATE ON CONTROL
IS INV SNR1 ON?
N
Y
DUPLEX MODE ?
N
Y
3
DUAL INVSNR1 ON CONTROL
2
DUPLEX INVSNR1 ON CONTROL
IS INV SNR2 ON?
N
Y
IS INV SNR2 ON?
N
Y
A
B

FIG. 36(b)

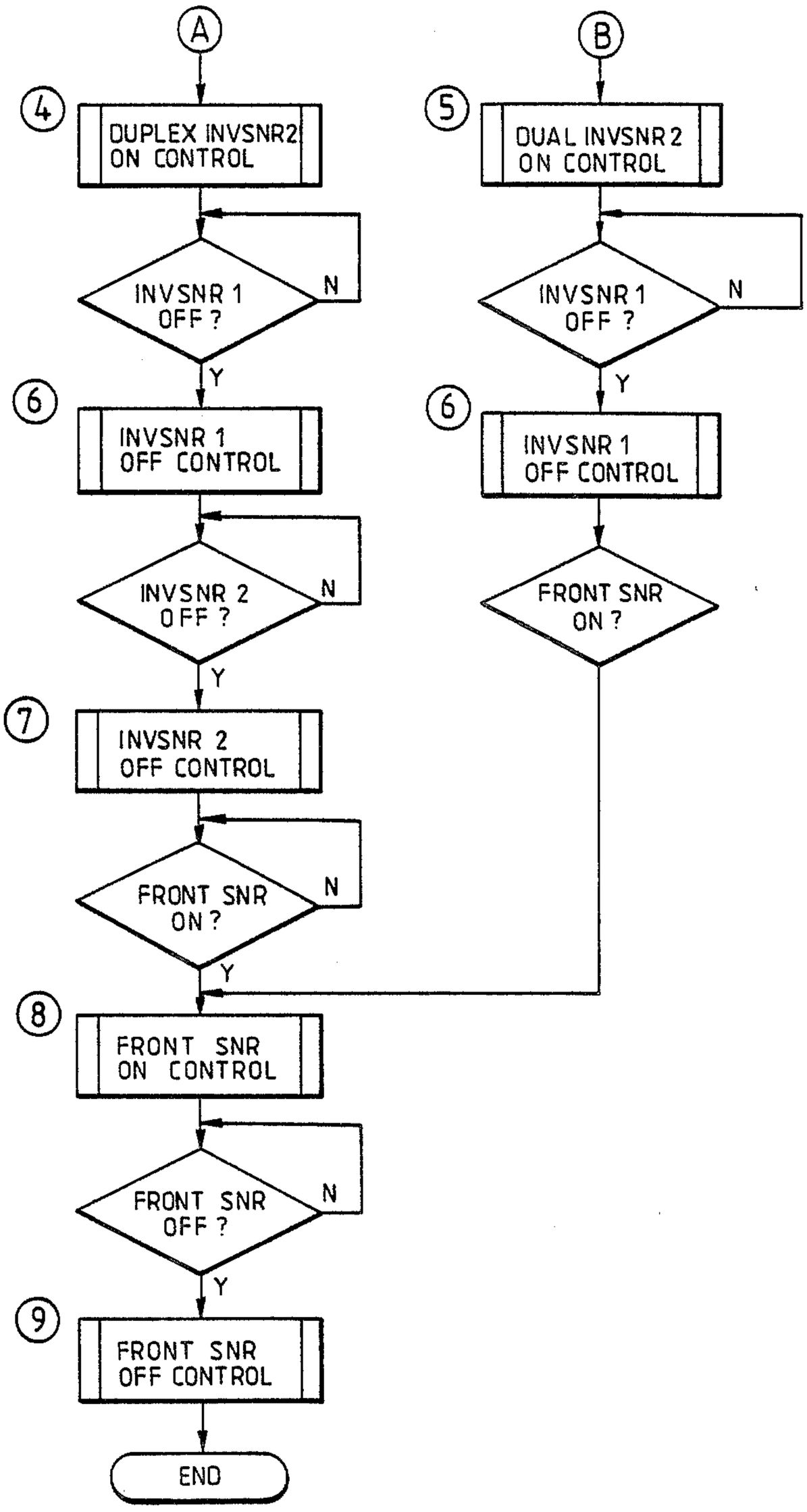

A
B
4
5
DUPLEX INVSNR2 ON CONTROL
DUAL INVSNR 2 ON CONTROL
INVSNR 1 OFF ?
N
Y
6
INVSNR 1 OFF CONTROL
INVSNR 2 OFF ?
7
INVSNR 2 OFF CONTROL
FRONT SNR ON ?
8
FRONT SNR ON CONTROL
FRONT SNR OFF ?
9
FRONT SNR OFF CONTROL
END

FIG. 37

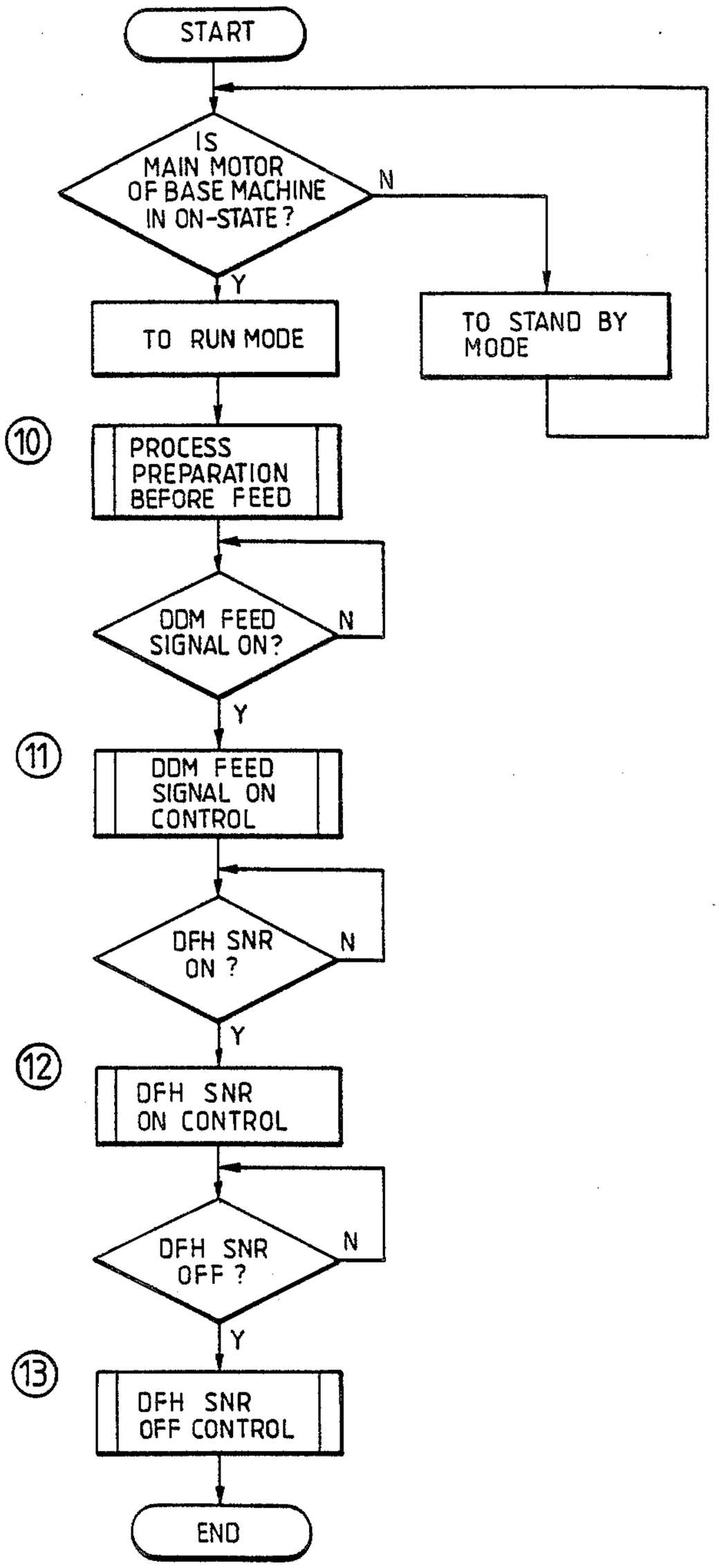

START
IS MAIN MOTOR OF BASE MACHINE IN ON-STATE?
N
Y
TO RUN MODE
TO STAND BY MODE
10
PROCESS PREPARATION BEFORE FEED
DDM FEED SIGNAL ON?
N
Y
11
DDM FEED SIGNAL ON CONTROL
DFH SNR ON ?
N
Y
12
DFH SNR ON CONTROL
DFH SNR OFF ?
N
Y
13
DFH SNR OFF CONTROL
END

FIG. 38

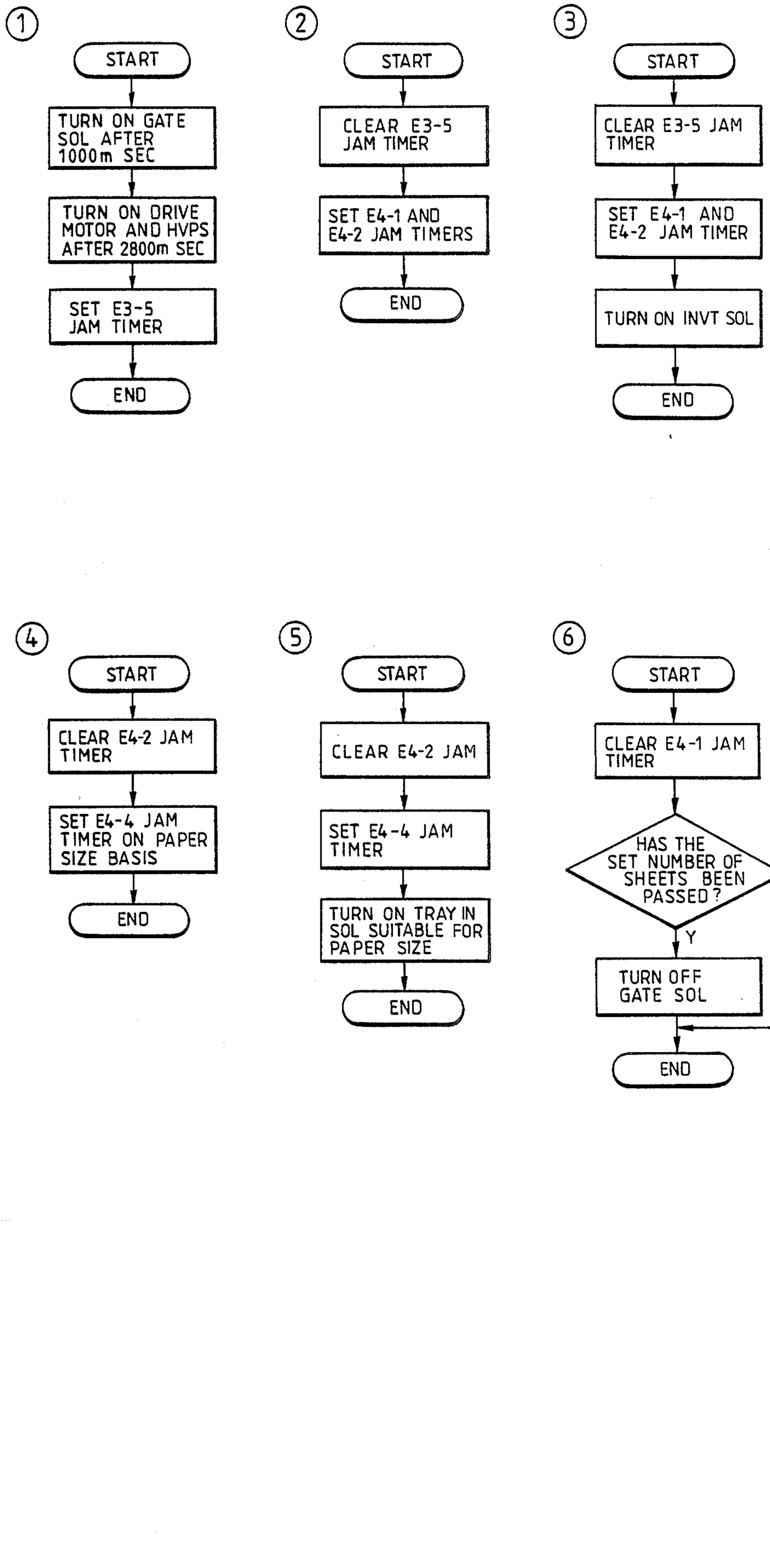

1
START
TURN ON GATE SOL AFTER 1000m SEC
TURN ON DRIVE MOTOR AND HVPS AFTER 2800m SEC
SET E3-5 JAM TIMER
END
2
START
CLEAR E3-5 JAM TIMER
SET E4-1 AND E4-2 JAM TIMERS
END
3
START
CLEAR E3-5 JAM TIMER
SET E4-1 AND E4-2 JAM TIMER
TURN ON INVT SOL
END
4
START
CLEAR E4-2 JAM TIMER
SET E4-4 JAM TIMER ON PAPER SIZE BASIS
END
5
START
CLEAR E4-2 JAM
SET E4-4 JAM TIMER
TURN ON TRAY IN SOL SUITABLE FOR PAPER SIZE
END
6
START
CLEAR E4-1 JAM TIMER
HAS THE SET NUMBER OF SHEETS BEEN PASSED?
N
Y
TURN OFF GATE SOL
END

FIG. 39

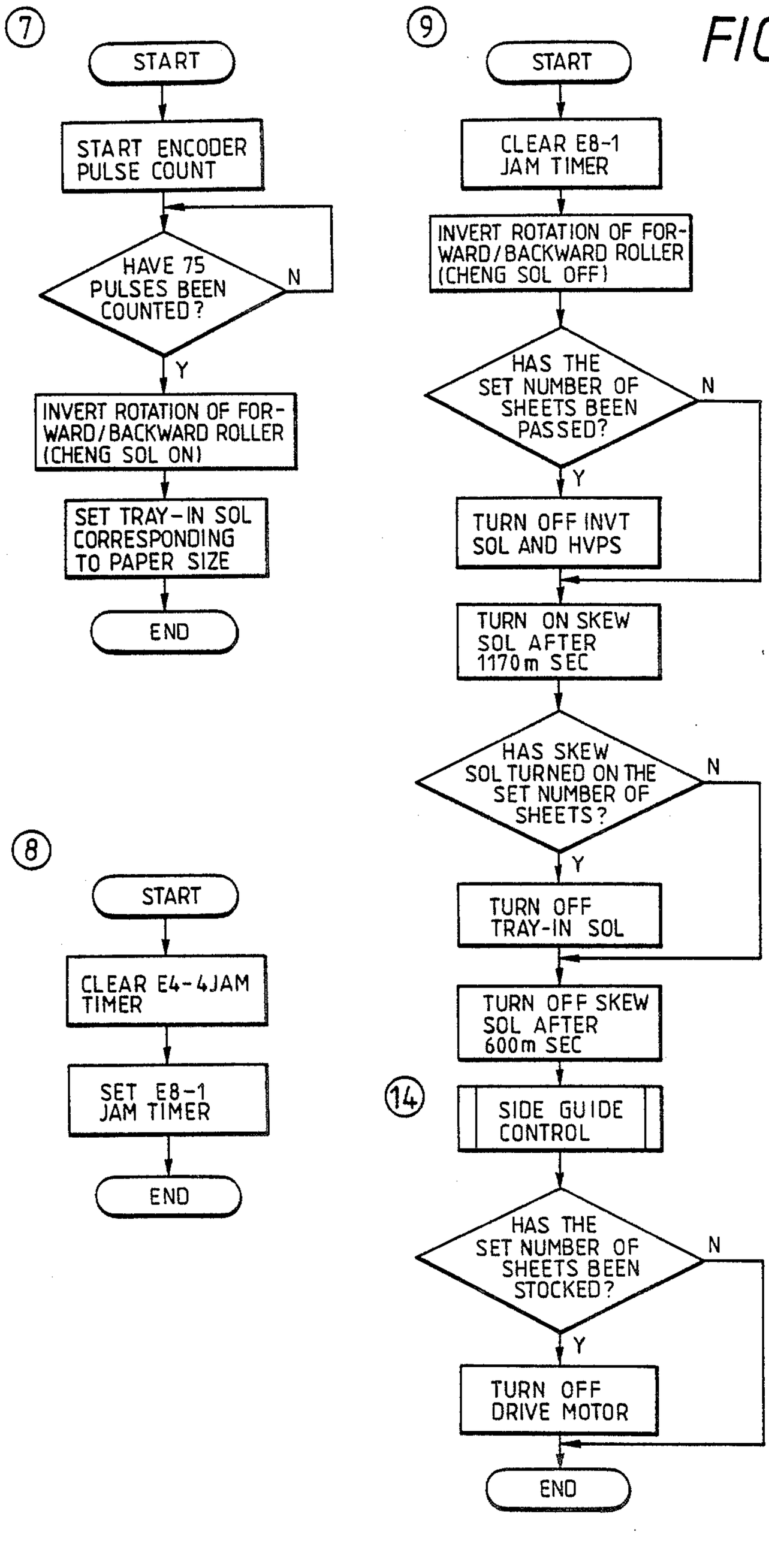

7
START
START ENCODER PULSE COUNT
HAVE 75 PULSES BEEN COUNTED?
N
Y
INVERT ROTATION OF FORWARD/BACKWARD ROLLER (CHENG SOL ON)
SET TRAY-IN SOL CORRESPONDING TO PAPER SIZE
END
8
START
CLEAR E4-4JAM TIMER
SET E8-1 JAM TIMER
END
9
START
CLEAR E8-1 JAM TIMER
INVERT ROTATION OF FORWARD/BACKWARD ROLLER (CHENG SOL OFF)
HAS THE SET NUMBER OF SHEETS BEEN PASSED?
N
Y
TURN OFF INVT SOL AND HVPS
TURN ON SKEW SOL AFTER 1170m SEC
HAS SKEW SOL TURNED ON THE SET NUMBER OF SHEETS?
N
Y
TURN OFF TRAY-IN SOL
TURN OFF SKEW SOL AFTER 600m SEC
14
SIDE GUIDE CONTROL
HAS THE SET NUMBER OF SHEETS BEEN STOCKED?
N
Y
TURN OFF DRIVE MOTOR
END

FIG. 40

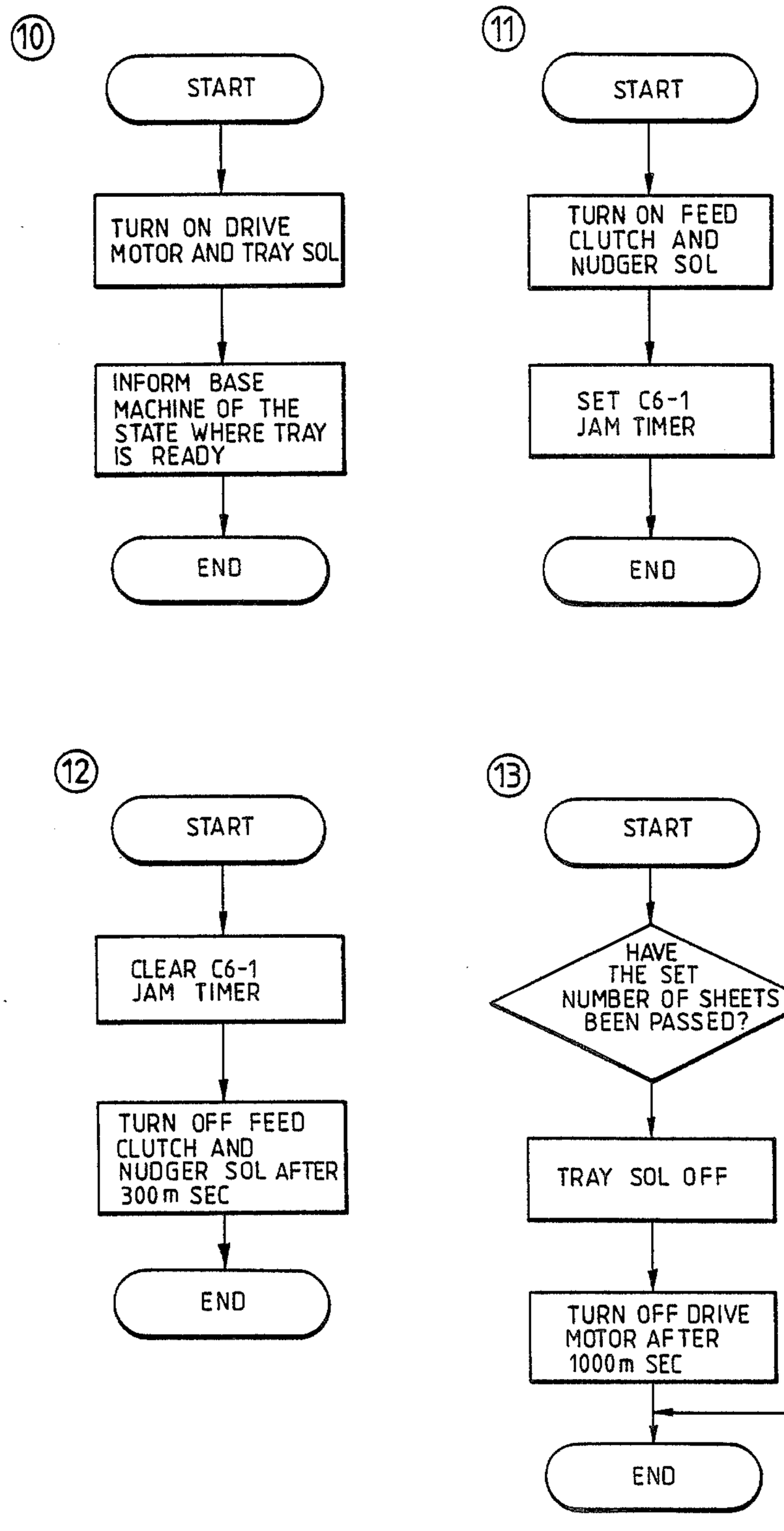

10
START
TURN ON DRIVE MOTOR AND TRAY SOL
INFORM BASE MACHINE OF THE STATE WHERE TRAY IS READY
END
11
START
TURN ON FEED CLUTCH AND NUDGER SOL
SET C6-1 JAM TIMER
END
12
START
CLEAR C6-1 JAM TIMER
TURN OFF FEED CLUTCH AND NUDGER SOL AFTER 300m SEC
END
13
START
HAVE THE SET NUMBER OF SHEETS BEEN PASSED?
TRAY SOL OFF
TURN OFF DRIVE MOTOR AFTER 1000m SEC
END

FIG. 41(a)

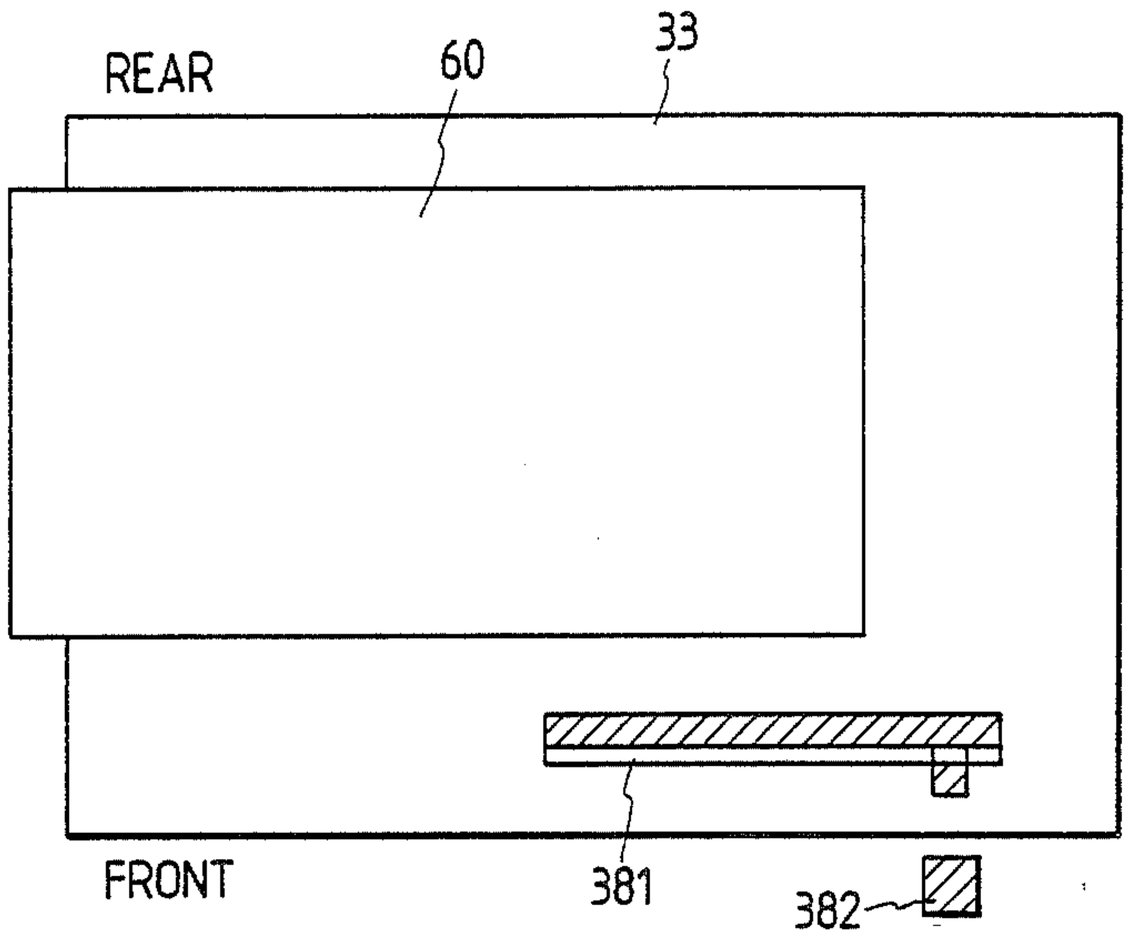


FIG. 41(b)

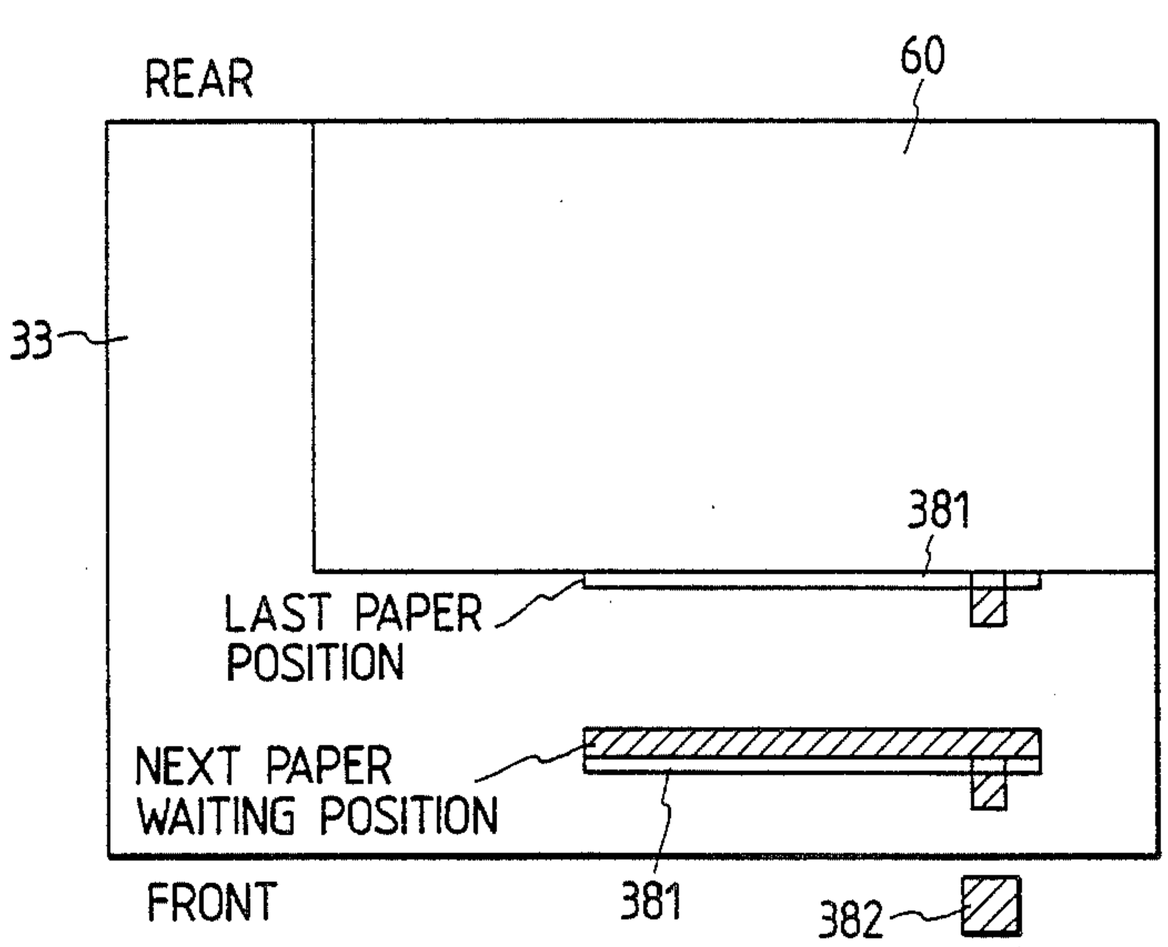


FIG. 42

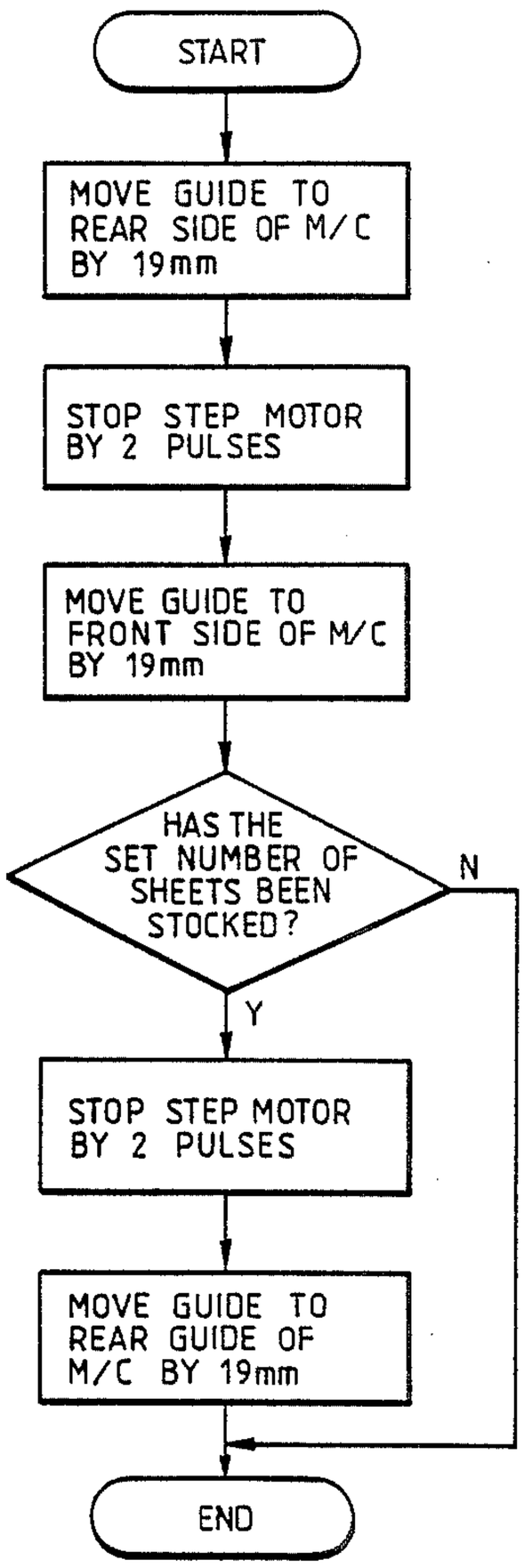

START
MOVE GUIDE TO REAR SIDE OF M/C BY 19mm
STOP STEP MOTOR BY 2 PULSES
MOVE GUIDE TO FRONT SIDE OF M/C BY 19mm
HAS THE SET NUMBER OF SHEETS BEEN STOCKED?
N
Y
STOP STEP MOTOR BY 2 PULSES
MOVE GUIDE TO REAR GUIDE OF M/C BY 19mm
END

FIG. 43

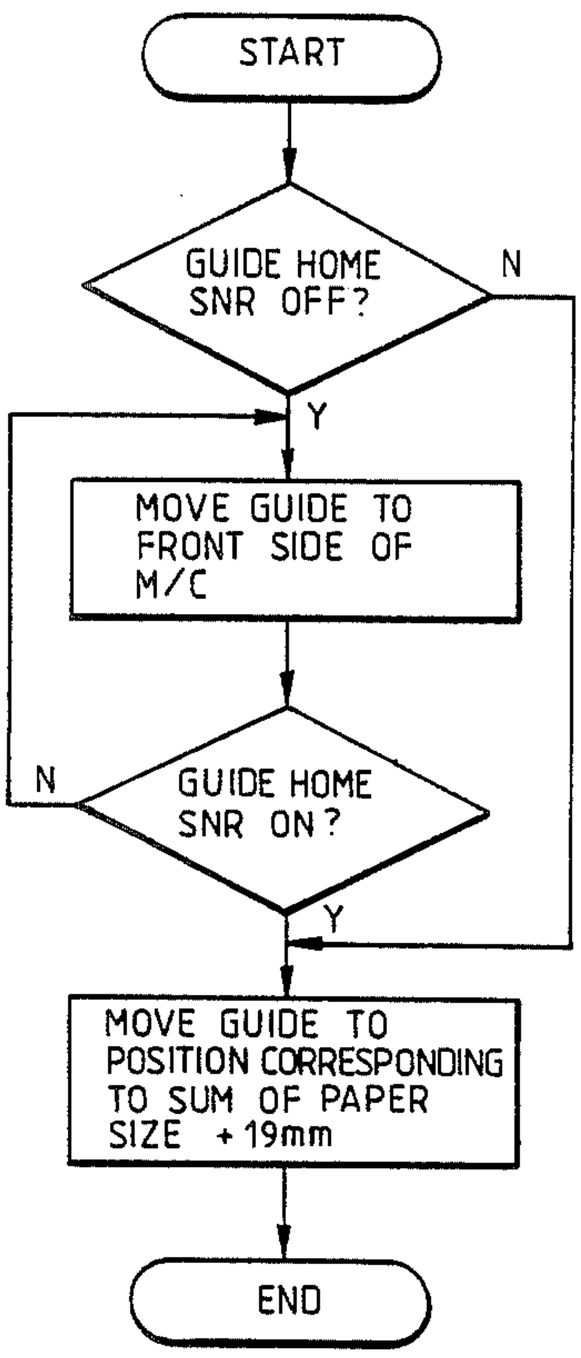

START
GUIDE HOME SNR OFF?
N
Y
MOVE GUIDE TO FRONT SIDE OF M/C
N
GUIDE HOME SNR ON?
Y
MOVE GUIDE TO POSITION CORRESPONDING TO SUM OF PAPER SIZE + 19mm
END

FIG. 44

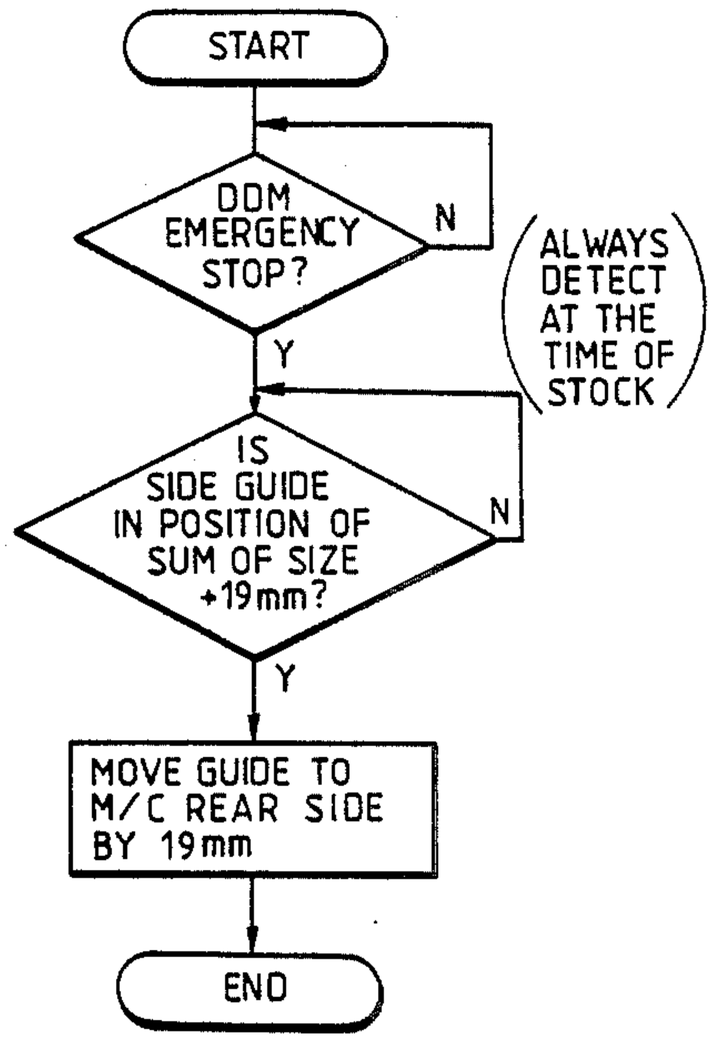
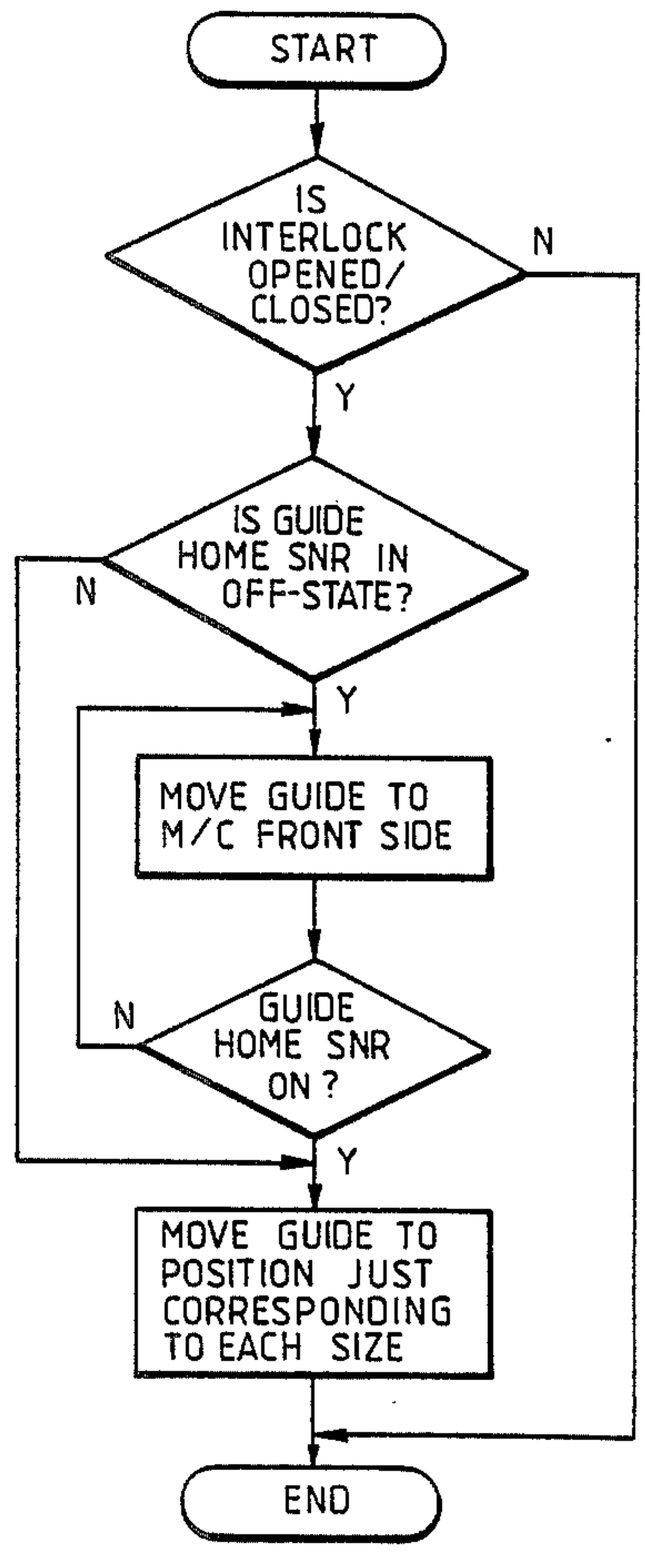

START
DDM EMERGENCY STOP?
N
Y
ALWAYS DETECT AT THE TIME OF STOCK
IS SIDE GUIDE IN POSITION OF SUM OF SIZE +19mm?
N
Y
MOVE GUIDE TO M/C REAR SIDE BY 19mm
END

FIG. 45


START
IS INTERLOCK OPENED/ CLOSED?
N
Y
IS GUIDE HOME SNR IN OFF-STATE?
N
Y
MOVE GUIDE TO M/C FRONT SIDE
N
GUIDE HOME SNR ON?
Y
MOVE GUIDE TO POSITION JUST CORRESPONDING TO EACH SIZE
END

PAPER TRAY CONTROL SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to recording apparatus such as copying machines, facsimiles, printers, etc. for recording image data and more particularly to a paper tray control system for use in an apparatus in which various additional devices can be fitted to its base machine.

2. Prior Art

With the spreading use of copying machines in recent years, user requirements tend to become diversified and those which have sophisticated functions have been developed and put on the market in order to deal with the diversified requirements. Relatively new functions being performed by those copying machines include a function of setting a copy contraction/expansion ratio of an original optionally adjustable at the rate of 1% of its dimension, a multicolor copying function using more than two kinds of toner, a monochromatic copying function using one selected color: a continuous copying function on a page-to-page basis by which double-spread two pages of a bookbinding original are copied without moving the original itself; a function of automatically continuously copying both sides of an original or of automatically continuously copying both sides of copied paper; and editing function by which a plurality of originals are edited and copied through synthesizing them or deleting some of them; a job memory function by which copying conditions stored in IC cards are inputted to set the copying conditions automatically; and many other functions.

The trend is for not only copying machines but also other kinds of recording apparatus such as facsimiles and printers for recording image data to be commonly made multifunctional and sophisticated.

Even though the apparatus is set multifunctional, however, all of its functions are rarely employed at all times but some of them are rather partially used, depending on the business or place in which it is installed. Consequently, there has been adapted an arrangement of models ready for supply, ranging from high-class models equipped with all sorts of functions up to special models offering a combination of various functions so that users are allowed to select one of the models capable of meeting their requirements. Moreover, some models are designed so that additional devices are attached in conformity with user requirements to their satisfaction. In any case, a function selective mechanism comprising various switches, buttons or keys is disposed on the console panel in order that any desired functions can be selected from among those provided and started.

An intermediate tray is also one of the additional devices fitted to a copying machine. Once the intermediate tray is added thereto, the paper used to record data can be stocked thereon and reused to record new data. In other words, one sheet of paper can be used to record data several times. A stock mode of the intermediate tray consists of a dual mode in which paper is stocked in such a manner that the preceding recording side is set as a recording side again and a duplex mode in which the back of the preceding recording side is set as a recording side. When the intermediate tray is used in the one or the other mode, the paper used for recording in the body is conveyed up to and stocked on the intermediate tray before being fed to a recording means

of the body. Consequently, a conveyer line becomes long and, particularly when a plurality of sheets of paper are continuously designated for recording, the plurality of sheets are involved on the conveyer line extending from the recording means up to the tray. A jam check is therefore imposed on not only the conveyer line of the body but also that of the intermediate tray.

While the aforesaid apparatus is made multifunctional and sophisticated, it ought to become convenient to its user and offer a wide range of application to that extent. On the other hand, it has also posed various problems. In the case of a copying machine equipped with the intermediate tray as an additional device, for instance, copies can be taken in the duplex mode and this makes it necessary to arrange a control circuit for use in taking a one-side copy of a one-side original and a duplex copy of a one-side original. Provided an original autofeeder for use in duplex coping is installed, moreover, a duplex original-duplex copy mode is further added. In the copying machine having the intermediate tray, copy-taking becomes possible in color-making, continuous copying color dualizing, sheet dualizing, parallel dualizing and partial color conversion modes even in the dual mode. As a result, an apparatus adapting a control system capable of exercising control in those modes has to be designed. As the control system varies with the specification of the apparatus, a control device has to be designed to suit each function thereof. Taking a tray for storing recording paper as an example, software for controlling an intermediate tray for duplex recording and editing purposes is provided in a ROM as what is used to control the apparatus proper when the intermediate tray in addition to general trays is installed as an additional device. Accordingly, the memory area of the apparatus proper is ate away as the number of functions added increases.

If attention is turned to part of control on the intermediate tray module (DDM) side, for instance, what becomes necessary on the part of DDM is data of the length and width of paper to be stocked. Accordingly, data on whether the kind of paper for use is of the AB or inch series and what size the paper is has to be specified; the problem is that the number of items of data to be specified increases as the number of paper sizes increases. In case an emergency interrupting situation occurs in the course of conveying paper, it becomes problematical how it has to be dealt with and what kind of control should be exercised therefore. When the main machine is stopped in case of emergency; e.g., jamming or interlock opening, sheets of paper stored in the DDM are set free and displaced as the tray is drawn out. For this reason, jamming and skewing may occur immediately after the operation of the apparatus is restarted.

Procedure and control peculiar to each apparatus becomes necessitated once additional devices are attached and the control system varies as the specification of the apparatus is changed, for example, because of the presence or absence of the additional device. Consequently, its control unit has to be so designed as to suit each combination of additional devices and their functions. Accordingly, the memory area of the apparatus proper is ate away as the number of functions added increases.

SUMMARY OF THE INVENTION

The present invention is intended to solve the aforesaid problems and it is therefore an object of the invention to provide a paper tray control system which permits attaching additional devices, standardizing programs for controlling an apparatus proper, irrespective of the presence or absence of the additional devices and economizing a memory area in the apparatus proper.

It is another object of the present invention to provide a paper tray control system which permits efficiently controlling an intermediate tray installed as an additional device in a manner specifically required for the intermediate tray, standardizing programs for controlling an apparatus proper and economizing a memory area in the apparatus proper.

In view of the foregoing, the paper tray control system for an apparatus so constituted according to the present invention as to set a paper tray attachable as an additional device as shown in FIG. **1A** comprises a main control means **13** for controlling a base machine **12** and a tray control means **15** for controlling a paper tray **14**, and is characterized in that a communication line **17** connects the main control means **13** and the tray control means **15** to have the tray controlled under instructions from the main control means **13**. Accordingly, programs for controlling the paper tray as an additional device in this system are provided in a memory **16** of the tray control means **15**, whereas the tray control means **15** selects a program stored in the memory **16** under instructions from the main control means **13** and starts its operation. The matching of the tray control means **15** with other units and functions are totally established by the operating signal controlled by the main control means **13**.

Further, the stock control system for an apparatus so constituted according to the present invention as to set a paper tray attachable as an additional device as shown in FIG. **1B** comprises a main control means **13** for controlling a base machine **12** and a tray control means **15** for controlling a paper tray **14** and is characterized in that a communication line **17** connects the main control means **13** and the tray control means **15** to have the tray controlled under instructions from the main control means **13**. Size data included in the stock control instructions is transmitted from the main control means **13** to effect the operation of fitting the size of sheets of paper sent for stocking, whereas a stock control mechanism **18** is controlled so that it is stopped after the paper in the course of being stocked by the tray control means **15** has been stocked completely.

In the paper tray control system with the aforesaid means thus provided according to the present invention, on receiving data and instructions as to paper tray control from the main control means **13**, the tray control means **15** under the control of the main control means **13** judges the paper tray control mode involved according to the data and controls the storage and feeding of paper. When the intermediate tray having the duplex and dual modes is set, for instance, the designated side of paper is turned up while it is being stored on the intermediate tray, depending on which mode, i.e., the duplex or dual mode, is designated. In other words, the conveyer line is controlled so that the paper with its copied side turned up is stored when the dual mode is designated.

In the paper tray control system with the aforesaid means thus provided according to the present invention, data of paper size included in the instructions as to the stock control over the paper tray is transmitted from the main control means **13** to the tray control means **15** to effect the setting of the size of the paper to be stocked on the intermediate tray by the tray control means **15**. Thereafter, sheets of paper are conveyed in conformity with the set number of them without designating the paper size each time one sheet of paper is conveyed. When the operation of the base machine **12** is interrupted because of jamming and interlock opening, moreover, the paper is also stopped from being stocked in accordance with the paper size set by the tray control means **15** on immediately transmitting an emergency interruption signal from the main control means **13**.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1A** and **1B** are block diagrams illustrating the principle of the present invention.

FIGS. **2–18** are illustrative of a copying machine to which the present invention is applied, in which;

FIG. **2** is a system configuration of a copying machine;

FIG. **3** is an external view illustrating an example of the system configuration of the copying machine;

FIG. **4** is a schematic block diagram of the copying machine;

FIG. **5** is a top view of a console panel of the copying machine;

FIG. **6** is a circuit diagram outlining a circuit configuration of the copying machine;

FIG. **7** is a developed block diagram of FIG. **6**, centering around a main CPU;

FIG. **8** is a block diagram illustrating the details of a circuit configuration around a photoreceptor drum of the copying machine;

FIG. **9** is a timing chart illustrating the operations of a main motor and a developing solenoid when first development is made by a sub-developing device and when second development is made by a main developing device;

FIG. **10** is a timing chart illustrating the operations of the main motor and the developing solenoid when first development is made by the main developing device and when second development is made by the sub-developing device;

FIG. **11** is a block diagram illustrating the details of an exposure system and the periphery of a console control unit of the copying machine;

FIG. **12** is a block diagram illustrating the details of a power supply and a fixing device of the copying machine;

FIG. **13** is a block diagram illustrating the details of a circuit configuration of a copy paper conveying system;

FIG. **14** is a schematic block diagram of a DADF;

FIG. **15** is a perspective view of a sorter;

FIG. **16** is a perspective view illustrating the system configuration of the copying machine fitted with an editor pad;

FIG. **17** is a top view of the editor pad; and

FIG. **18** is a top view illustrating an editor panel and a display panel;

FIGS. **19–45** are illustrative of an embodiment of the present invention, in which;

FIG. **19** is a schematic block diagram of an overall paper tray control system;

FIG. **20** is a serial communication timing chart;

FIG. **21** is a diagram illustrating the structure of serial communication data between a main controller and a tray controller;

FIG. **22** is a diagram explanatory of a serial reception signal;

FIG. **23** is a diagram explanatory of a serial transmission signal;

FIG. **24** is a diagram illustrating an intermediate tray control system configuration;

FIG. **25** is a schematic view of a conveyor system centering around the intermediate tray;

FIG. **26** is a diagram exemplifying the operational timing of an intermediate tray module;

FIG. **27** is a diagram exemplifying a fourth-fifth supply tray control system configuration;

FIG. **28** is a diagram exemplifying a large capacity tray control system configuration;

FIG. **29** is a schematic block diagram of a paper supply means equipped with the intermediate tray and the large capacity tray as additional devices;

FIG. **30** is a schematic block diagram of a paper supply means equipped with the fourth and fifth supply

FIG. **31** is a diagram exemplifying the operational timing of the fourth and fifth supply trays;

FIG. **32** is a diagram exemplifying the operational timing of the large capacity tray;

FIG. **33** is a diagram illustrating a general tray control flow;

FIG. **34** is a diagram illustrating a stock control process flow for the intermediate tray;

FIG. **35** is a diagram illustrating a size identifying process flow while power is on;

FIG. **36** is a diagram illustrating a control flow at the time of a DDM stock mode;

FIG. **37** is a diagram illustrating a control flow at the time of DDM feeding;

FIGS. **38–40** are illustrative of details of the process steps of FIGS. **35–37**;

FIG. **41** is a diagram explanatory of the operation of a side guide;

FIG. **42** is a diagram illustrating a side guide control flow with a DDM front sensor in the off-state at the time of the stock mode;

FIG. **43** is a diagram illustrating a side guide initial setting control flow in the stock mode;

FIG. **44** is a diagram illustrating a side guide control flow at the time of DDM emergency interruption; and

FIG. **45** is a diagram illustrating a side guide control flow after the closing of a DDM tray interlock followed by the opening thereof in a feed mode.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A detailed description will subsequently be given of an embodiment of the present invention.

Contents:

In this embodiment, a copying machine is taken up as an example of a recording apparatus and reference will be made to an intermediate tray employed as duplex and duel modules, a large capacity tray, and an ordinary additional paper supply tray which are added separately from paper trays incorporated in the copying machine proper, together with selective displays by way of example. Prior to the description of the embodiment to be given, headings of the description thereof will be shown. In the following description, (1)–(5) refer to the overall construction of the copying machine to which the present invention is applied and (6) to the embodiment wherein a paper tray control system according to the present invention is adopted with the aforesaid arrangement.

(1) System configuration of copying machine.
(2) Software package.
  (2-1) Advantages of software combination; and
  (2-2) Examples of differentiation.
(3) Construction of exemplified apparatus.
(4) Circuit configuration of the apparatus.
(5) Detailed circuit configuration of copying machine:
  (5-1) Periphery of photoreceptor drum;
  (5-2) Switching mechanism of developing device;
  (5-3) Optical system;
  (5-4) Fixing device;
  (5-5) Control of console;
  (5-6) Billing counter;
  (5-7) Power supply;
  (5-8) Conveying system;
  (5-9) DADF;
  (5-10) Sorter; and
  (5-11) Editor pad.
(6) Paper tray control system (the embodiment of the present invention):
  (6-1) Paper tray;
  (6-2) Outline of paper tray control system;
  (6-3) Serial communication system;
  (6-4) Intermediate tray control system;
  (6-5) Operational timing of intermediate tray module;
  (6-6) Other paper tray control system and its operational timing; and
  (6-7) Intermediate tray control system.

(1) System configuration of copying machine

FIG. **2** is a system configuration of a copying machine in the embodiment of the present invention.

As shown in FIG. **2**, the copying machine applicable in the present invention is designed so that its function can be upgraded by attaching desired additional devices to a vase machine **21** as the most basic component. The base machine in this case is equipped with a one stage supply tray and a manual feed tray and capable of taking a copy of an original manually set on a platen glass plate. The following additional devices can be attached to the base machine:

(1) IC card device **22**;

An IC card device **22** is used to supply necessary data to the base machine **21** using IC cards on one hand and to write data from the base machine **21** to the IC cards on the other. Data (coordinate data) is read by means of an editor pad as will be described later, when the editor pad is connected to the IC card device **22** to carry out the input operation. The IC card device **22** in this embodiment is designed to control the IC card and the editor pad alternately but it is not possible to read data simultaneously using both of them.

The IC card for use in the IC card device in this embodiment has an ISO type interface with a memory capacity of 2 kilo-bytes. The use of IC cards permits not only the storage of complicated data therein but also the automated and multifunctional operation of a copying machine. By providing IC cards classified by industries or customers, for instance, a copying machine operating method agreeable to each group of owners can be implemented even if the copying machine has complicated

functions. Accordingly, copying machines becomes quite easy to operate without errors.

(2) ADF **23** and DADF **24**;

An ADF **23** is generally called an automatic original feeder and designed to feed originals one after another onto the platen glass plate of the base machine **21** and to discharge the original after completion of development; only one predetermined side of the original is exposed to light. On the other hand, a DADF **24** is of a duplex type, i.e., an automatic original feeder for use in copying both sides of an original.

The DADF **24** operates to convey an original in such a manner that one side of the original faces the platen glass plate to effect a first exposure and then to turn the exposed original upside down before returning it to the tray of DADF **24**. As a result, what is opposite to the exposed side is then exposed when the original is fed again. The base machine **21** is arranged so that two sides of copying paper can be used independently for copying while it is equipped with the additional devices as will be described later.

As the ADF **23** and the DADF **24** are usable for the copying machine in this embodiment, copy-making operations can be conducted automatically to copy both sides of originals and copies in combination.

The ADF **23** is basically the same in construction as any of the automatic original feeders heretofore for use in copying machines. In the case of this embodiment, however, originals are inserted left to right facing the apparatus to prevent them from overflowing the base machine **21**.

(3) Ordinally platen **25** and platen **26** with editor pad.

An platen **26** with an editor pad is provided with a coordinate input device called an editor pad for editing originals on the platen. An ordinary platen **25** is not equipped with such a mechanism.

(4) Console panel;

There are two kinds of console panels: one **27** which is of a back lit type and the other **28** with a message display. The console panel **27** of the back lit type has a display panel on which messages are arranged in predetermined locations and the massages are selectively lit by a lamp or the like in order to make them readable.

The console panel **28** with a message display adapted in this embodiment is formed with liquid crystal elements whose advantage is that various messages can be displayed anytime within a relatively small area of display. Decision on which one of the console panels should be employed may be made on a copying machine basis in consideration of complication in the system configuration and operability of the copying machine.

(5) Addition of feed tray;

There has already been proposed a typical form of adding a large capacity tray as disclosed in Japanese Patent Application (OPI) No. 77140/82. In this embodiment, however, feed trays in combination which can meet the needs of customers have been adapted. A detailed description has been given of the combination of such feed trays in, e.g., Japanese Utility Model Application (OPI) No. 081016/86 by the present applicants under "Multistage Paper Feed Copying Machine."

(a) Second and third feed trays **31-2** and **31-3**.

With the addition of these two feed trays, copying paper of maximum three different sizes can be fed to the base machine **21**.

(b) Second and third feed trays **31-2**, **31-3** and intermediate tray **33**.

An intermediate tray **33** in this case is employed to accommodate copying paper already used for copying temporarily when one side of the paper is used for copying a plurality of times or when both sides thereof is alternately used for copying.

(c) Second and third feed trays **31-2**, **31-3**, intermediate tray **33**, and fourth and fifth feed trays **1-4**, **31-5**.

(d) Second and third feed trays **31-2**, **31-3**, intermediate tray **33**, and large capacity tray.

A large capacity tray herein described is a feed tray capable of accommodating several thousand sheets of copying paper.

(6) Discharged copying paper receiving device;

Copying paper is normally received by a discharge tray **37**. There are provided a 10-bin sorter **38** and a 20-bin sorter **39** in this system. Consequently, copies can be sorted by maximum **10** or **20** distributees if the 10- or 20-bin sorter is set.

As set forth above, the additional devices can be fitted selectively to the base machine **21** in the copying machine system and therefore the most suitable copying machine is offered to the customer. Moreover, the functional upgrading of the copying machine can be attained as business routine on the part of the customer changes.

The purchase of a single unit of base machine **21** may often be fit for customers who do not want to obtain enlarged or contracted copies of originals or a large number of copies at a time. On the other hand, those who need a large number of copies or complicated copy-making operations may often require securing the intermediate tray **33** and the large capacity tray. This coping machine system is designed for each additional device to be simply replaced and detached in order to satisfy such versatile requirements, whereas an independent CPU (Central Processing Unit) is provided for a group of additional device to effect decentralized control by a plurality of CPUs. By this is meant that products for which customers seek become readily available and, in addition to this merit, that the possibility of newly attaching additional devices teach them an innovation in copy-making operations. In view of this, the copying machine system appeals to customers a great deal in that it helps increase the productivity of office business processing.

(2) Software package.

(2-1) Advantage of software combination.

The system configuration of the copying machine as described above can also be detailed by reference to the software combination thereof. More specifically, since various additional device can be fitted to the copying machine, the software is provided so that it conforms to the system configuration corresponding to an arrangement of additional devices.

One of the reasons for the adaption of such software package is (i) that, if control programs for use in operating all of the additional devices are to be provided in the base machine **21**, the memory capacity required would become enormous. Another reason is (ii) that, when additional devices are newly developed in a future or when any improvements are made in the existing ones, they can be utilized without the replacement of the ROM (Read Only Memory) in the base machine **21** or the addition of a new one.

Accordingly, there are provided two areas in the base machine **21**: a basic storage area for use in controlling the basic part of the copying machine; and an additional

storage area where the programs read from IC cards are stored. In the additional storage area, various programs for controlling the ADF **23**, the DADF **14**, the console panel **28**, etc. are stored. When an IC card is set in the IC card device **22** after the predetermined additional devices are fitted to the base machine **21**, a program necessary for copy-making operations is read out and loaded on the additional storage device. The program thus loaded is used to control the copy-making operation in cooperation with the program written to the basic storage area of as what is given priority over the other.

(2-2) Example of differentiation.

The program stored in the IC card controls the functions of the copying machine in this embodiment. Accordingly, one mode of operating the copying machine can be differentiated from the other by replacing the card with a new one which stores a different program. A description will subsequently be given of the differentiation by referring to some examples.

As a first example, a copying machine for common use is installed in a building housing a number of independent business institutions or in a company or factory having different departments or sections. The installation of a copying machine for common use in the latter case is required in view of budget control and an instrument such as a copy-riser is normally employed to control service conditions on a department or section basis.

It is also assumed that the copying machine has a relatively high-grade system configuration comprising, as shown in FIG. **2**, the base machine **21**, the IC card device **22**, the DADF **24**, the sorter **38**, the console panel **28**, the second-fifth feed trays **31-2**~**31-5** and the intermediate tray **33**. The joint users or sections include those who need no DADF **24**, sorter **38** nor additional devices.

If all the expenses for the use of the copying machine were to be divided among the users or sections whose operational requirements differs with the copying volume, those taking copies of little volume would be very much opposed to introducing a copying machine equipped with various additional devices and this makes it extremely difficult to mediate between the high- and low-degree users or sections.

Such a problem can be solved by allotting an IC card to each user or section according to the operation rate so as to let the users or sections wishing high-grade functions bear greater basic expenses in proportion to the operation rate. In this manner, many functions can be utilized. The owner of the highest grade IC cards, for instance, is allowed to freely use the DADF **24**, the sorter **38**, the second-fifth feed trays **31-2**, **31-5** and the intermediate tray **33** by operating the copying machine while the IC card is set in the IC card device **22** to ensure the improved efficiency business. On the other hand, the user who does not want to have copying paper sorted can save the expenses by setting an IC card lacking a sorting program and employing the uppermost bin of the sorter **38** as a discharge tray.

As a second example, assuming that a trader is running a self-copy service store using IC cards.

There are a plurality of copying machines disposed in the store, the copying machines being equipped with IC card devices, respectively. Each customer asks for an IC card corresponding to the desired mode of service, so that he can take copies on a self-service basis by setting the IC card in the desired copying machine. The customer who is unfamiliar with the operation of copying machine may be given an IC card incorporating an operational instruction display function in the program and, by setting the IC card, can take copies errorlessly according to the operational data displayed on the console panel **28**. Whether or not the use of the DADF **24** or the execution of multicolor recording is possible can be determined by a lend-lease IC card, whereas the storekeeper is capable of assigning a copying machine at a proper rate to a particular customer by limiting the copying machines for use. Moreover, the storekeeper is also able to take careful thought-out measures such as offering copying-fee discount service to regular visitors because he can instantly charge the fee therefor by writing copy-making data to the IC card, the data including the number of sheets, the size of copying paper used and so on.

As a third example, a description refers to service using an IC card storing a program intended for a specific user. In patent attorneys' offices, copies of relatively large magnification, e.g., 200% enlarged copies are often taken because of the necessity for making full-scale copies when patent gazettes contracted by the photomechanical process are examined. Moreover, the original drawings will have to be contracted or enlarged fractionally as requested by the government agency when they are submitted thereto. In the resident-card copy-making sections of municipal offices or ward offices, on the other hand, certified copies or abstracts of the originals are prepared with the deletion of image data in columns thereof where the data should be treated in confidence so as to protect the data of persons other than those claimed and their privacy.

In that manner, some users may demand to use copying machines in the special modes of use. If the functions of copying machines are set to meet such requirements, their console panels will become complicated in construction and moreover the ROMs inside the copying machines also become large in size. Consequently, IC cards classified by special users are used to provide copying machines having functions most suitable for such users by letting them set the IC card therein.

In the case of patent attorneys offices, for instance, the purchase of IC cards for special use allows them to simply select 200% contraction/magnification in addition to several ordinary kinds of contraction/magnification as fixed ones. It also becomes possible for them to set a contraction/magnification ratio adjustable over, e.g., 1% within the range of fine adjustments required. In the aforesaid resident-card copy-making sections, instructions concerning kinds of resident cards columns and items to be deleted, etc. can be given on liquid crystal displays by pressing keys such as ten keys and, by pressing the start key, the desired range of the original may be copied or the necessary contents thereof are edited before being recorded.

(3) Example of the construction of copying machine

FIG. **3** is an external view illustrating an example of the system configuration of the copying machine in the aforesaid embodiment.

In the copying machine in this embodiment, the DADF **24** is installed on the base machine **21** and the IC card device **22** is disposed on the rear surface thereof. The control panel **28** with a message display is laid on this side surface of the base machine **21**. A manual insert tray **41** (not shown) is fitted to the right side of the copying machine and the 10-bin sorter **38** to the left side

thereof. The manual insert tray **41** is used for manual feeding and a plurality of sheets of paper can be simultaneously set before being fed successively.

As set forth above, the base machine **21** is fitted with the first feed tray **31-1** as a basic component. In this copying machine, the second and third feed trays **31-2**, **31-3** are disposed under the first one, whereas the fourth and fifth feed trays **31-4**, **31-5** are arranged with the intermediate tray **33** sandwiched therebetween. All of these feed trays **31-1**~**31-4** and the intermediate tray **33** can be slid out to this side, so that not only the improvement of operability but also economy of space for the installation of the copying machine is accomplished. Moreover, this copying machine is neat and streamlined in design without the protrusion of the ADF (Automatic Draft Feeder) and the paper feed trays.

FIG. **4** is a schematic view of the copying machine, wherein a photoreceptor drum **51** is contained in the base machine **21**. The photoreceptor drum **51** is uniformly charged by a charge corotron (charger) **52** and turned at a fixed speed in direction of arrow **53**, the charged surface thereof is exposed to light in an exposure range **54**. Optical images of an original (not shown) placed on a platen glass plate **55** disposed on the base machine **21** are incident on the exposure range **54**. For this purpose, an arrangement is made of an exposure lamp **56**, a plurality of mirrors **57** for transmitting the light reflected from the surface of the original illuminated thereby and an optical lens **58**. Some of them as prearranged are scanned for the purpose of reading the original.

Electrostatic latent images corresponding to the original are formed on the phtoreceptor drum **51** by the image data exposed in the form of slits in the exposure range **54**. The electrostatic latent image is developed by a developing device **59** and converted to a toner image. The toner image moves as the photoreceptor drum **51** turns and passes by a transfer corotron (transfer device) **50**.

On the other hand, copying paper **60** contained on the first feed tray **31-1** fitted to the base machine **21** or manually fed along the manual insert tray **41** is sent out by a feed roll **61** or rolls **63** and guided by conveyer rolls **69** before bing passed between the photoreceptor drum **51** and the transfer corotron **50**. The toner images are transferred onto the copying paper **60** at this time. The copying paper **60** after the transfer is passed between a heat roll **66** and a pressure roll **67** and then subjected to heat fixing. Subsequently, the copying paper **60** is passed between conveyer rolls **68** and discharged onto a discharge tray (not shown).

The DADF **24** is fitted to the base machine **21** in this embodiment. Both sides of the original can thus be placed successively on the platen glass plate **55**. In this case, one side of each of the originals piled up in the original container of the DADF **24** is first set on the surface of the platen glass plate **55** and, at the point of time a copy is taken, the original is turned upside down and reset in the container. The original is then sent to the platen glass plate **55** again.

Although five trays **31-2**~**31-5**, **33** have been installed under the base machine **21**, simply a cabinet may be arranged instead so as to accommodate expendables. Moreover, the copying machine with the base machine **21** left intact may be mounted on a desk and used as a desk-top copying machine. Needless to say, only the second feed tray **31-2** may be installed under the first feed tray **31-1**, so that the copying machine with this arrangement is mounted likewise on a desk.

FIG. **5** is a top view of a console panel of the copying machine. The details of the art of display control as described hereinafter by the present applicants have been disclosed in Japanese Utility Model Application No. 130320/86 under the title of "Display Unit" and Japanese Utility Model Application No. 066170/86 under "Character Display Unit". Japanese Utility Model Application No. **130320/87**, for instance, discloses the prevision of a graphic display area through-a dot pattern in a copying machine, suggesting the use of the graphic display area in order to make various kinds of display. In a copying machine capable of copying part of an original, moving and deleting a picture, for instance, an image sensor reads an image in the area intended while the original is placed on the platen with the suggestion of displaying its contour in the graphic display area, whereby not only errors in area setting but also misoperation are prevented from occurring.

A plurality of console panels may be adopted. However, the console panel **28** with a message display is employed in the copying machine in the above-described embodiment.

A menu display plate **71** is arranged above the console panel **28** are the contents of the respective panel sections **74–79** are displayed with characters. A switch **81** and two display lamps **82** are disposed in the panel section **74** for the senter among them so that the sorting mode may be selected when the sorter is connected. The sorting mode consists of a stack mode in which sheets of copying paper are successively stacked and a gathering mode in which they are sorted in bins.

A switch **83** (i) for editing or correcting/identifying images; a switch **84** (ii) for having images stored in a job memory; a switch **85** (iii) for implementing various copying forms; a switch (iv) for taking duplex copies; and display lamps **82** for displaying whether or not these switches have been selected are disposed in the function selecting panel sections **75**. By the editing (i) is meant the function or reading data for editing by means of the editor, whereas the correcting/identifying means the function of displaying the input data in a liquid crystal display for identifying and replacing the data. The memory used in (ii) is a nonvolatile memory composed of a random access memory backed up by a battery. Other storage media such as an IC card, a magnetic card, a floppy disk, etc. are needless to say usable as a nonvolatile memory. Image density and magnification can be preset in this copying machine in order to reduce the operating load of the console panel **28** by the operator and the values thus preset are stored in the nonvolatile memory. When the switch **85** is pressed (iii), character data is displayed in the display panel section **79** of the console panel **28** and the desired function among "the other" ones can be selected.

The other functions in that case include (i) a continuous page copying function, (ii) a side canceling function and (iii) a binding-margin function. The continuous page copying function (i) among them is that of dividing an original extending over two pages like a book-binding original into two one-page sections while it is in the state of a double-spread page. The side canceling function (ii) is that of copying no image data on the periphery of the original so that the original looks as if it were surrounded with a "frame" on the periphery of the image data. The binding-margin function (iii) is such that a "binding margin" is set in the right-hand or left-

hand side portion of a copy. The binding margin having a desired length can be set and its value may be key boarded **80** at the console or selected from the values displayed then on the display panel **79**.

(iv) Finally, the duplex copy means taking copies on both sides of copying paper, respectively. When the duplex copy is made, the copying paper **60** with the first one side used for copying is delivered onto the intermediate tray **33** shown in FIG. **4**. Subsequently, the copying paper **60** is again sent out of the intermediate tray **33** and the other side thereof is used for copying. For monochromatic copying by means of this copying machining as will subsequently be described, the one side thereof is used twice for copying. In this case, it has been so contrived that the inside and outside of the copying paper being accommodated on the intermediate tray **33** are turned upside down.

On the menu display plate **71** shown in FIG. **5** are four display lamps **87** disposed in the uppermost portion of the monochrome emphasizing panel section **76** under the portion where "Emphasizing Monochrome" is displayed and used to indicate kinds of color developing agents (color). The lamp(s) corresponding to the color(s) presently set is lit because one or a plurality of color (out of four colors, e.g., red, blue, etc.) developing agents can be set in this copying machine.

Four switches **88–91** and display lamps **82** for displaying which one of the switches **88–91** has been set are disposed in the remaining portion of the monochrome emphasizing panel section **76**. The color marking switch **88** among them is (i) used for marking color. If this switch is pressed to specify the area where marking is made, that area is recorded with a light color superposed thereon, for instance, and the intended effect of marking is produced.

The continuous color dualizing switch **90** (ii) is used to record one color in the specified area of a copy. A figure to be displayed with color is placed on the, e.g., right-hand side of the platen glass plate **55** (see FIG. **4**), whereas an original is set on the left-hand side thereof. When a copy is made in the aforesaid condition, the image data of the original is copied in black and the figure is drawn thereon in one color. If the figure specified is formed of dots, the colored sigure adjusted to the desired density by the reproduction of the dots is then recorded in the specified area of copying paper. In addition, the names or designs of merchandise are set on one side of the platen glass plate **55**, whereas offering prices written on paper are arranged on the other, so that the standing prices thereof are readily displayed as one pattern of-copy-making operation.

When the partial color conversion switch **89** is selected (iii), only the specified area is copied in one color and the remaining portion is copied in black. On the other hand, the original is copied in one color when the monochromatic switch **91** is selected (iv).

In the copy density panel section **77** provided under the portion where "Copy Density" is displayed on the menu display plate **71** are display lamps **83** indicating which one of the five stage copy densities has been selected and shift keys **94**, **95** for selecting one of the copy densities. The upper shift key **94**, when pressed, is used to decrease the copy density, whereas the lower shift key **95** is used to increase the copy density. The copy density can be adjusted by changing the developing bias of the developing device **59** shown in FIG. **4**; changing the quantity of light from the exposure lamp **56** (FIG. **4**); and changing the quantity of charge given by the charge corotron **52** relative to the photoreceptor drum **51**. In this embodiment, the developing bias can be adjusted to, e.g., 16 stages.

An automatic density adjusting switch **97** is arranged under the copy density panel section **77**. When the automatic density adjusting switch **97** is pressed, an automatic density display lamp **98** is lit to provide an automatic density adjusting mode. In the automatic density adjusting mode, part of the light reflected from the original when the original is scanned and arriving at the photoreceptor drum **51** is taken by the half mirror and the potential of the developing electrode within the developing device **59** is set, depending on the proportional quantity of that part of light.

In the magnification paper selection panel section **78** provided under "Optional Magnification" on the menu display plate **71** are a display section for setting the magnification desired on the left-hand side thereof and a paper selecting section on the right-hand side thereof.

A magnification table display **99** is provided in the section where magnification is set and displayed. In this copying machine, 50-to-200% magnifications can be set optionally at a rate of a 1% point (linear magnifications) and the magnification thus set is displayed in the magnification table display **99**. The magnification display is set by either operating shift keys **101, 102** optionally or selecting the predetermined fixed magnification.

When the optional magnification is set, the shift keys **101, 102** are operated. The upper shift key **101**, when pressed, is used to increase the magnification by 1%, whereas the lower shift key **102** is used to decrease the magnification by 1%. While the shift keys **101, 102** are kept being pressed, the magnification increases continuously at a rate of 1%.

The selection of the fixed magnification is made by a fixed magnification key **103**. The fixed magnification is displayed on a magnification display plate **104** and, in this embodiment, can be selected from among 141.4%, 86.5%, 81.6 and 70.7%. In addition, 100% as an equimultiple may be selected. Which one of the magnifications has been selected is made known by display lamps **82** disposed next on the left-hand side of the display plate **104**.

In the copying paper selecting section above are eight display plates **105** for displaying paper sizes and shift keys **106, 107** for selecting one of the sizes. Display lamps **82** are disposed next to the eight kinds of display plates **105**, the lamps **82** being used to display which one of the copying papers or sizes has been selected. The following are displayed in the display plate **105** in this embodiment:

(i) Display of manual insert tray;

When the manual insert tray **41** (FIG. **4**) is used, this display is selected. A conventional manual insert tray is designed to feed a sheet of copying paper at a time and it is only necessary for the operator to feed the copying paper with priority given to the manual insert tray, whereas the operator need not select the manual insert tray itself. On the other hand, a plurality of sheets of copying paper can simultaneously be set on the manual insert tray **41** in this embodiment. If copying paper is set by having the manual insert tray **41** convey the paper, the plurality of sheets of copying paper may start being fed at the point of time they are being set. In order to avoid the situation above, the selection of the manual insert tray **41** is displayed.

(ii) A3 paper display;

This display is selected when copying paper of A3 size is used in the longitudinal direction.

(iii) B4 paper display;

This display is selected then copying paper of B4 size is used in the longitudinal direction.

(iv) A4 paper display;

This display is selected when copying paper of A4 size is used in the longitudinal direction.

(v) B4 paper display;

This display is selected when copying paper of B5 sizes used in the longitudinal direction.

(vi) A4 crosswise paper display;

This display is selected when copying paper of A4 size is used in the direction perpendicular to its longitudinal direction.

(vii) B5 crosswise paper display;

This display is selected when copying paper of B5 size is used in the direction perpendicular to its longitudinal direction.

(viii) Nonstandard paper display;

This display is selected when nonstandard paper is used.

An automatic paper/magnification selecting switch **109** is arranged under the magnification paper selection switch **78**. When this switch **109** is pressed, the automatic/magnification selecting switch **109** is selected and a combination of preset magnification and paper size is selected. The operator can thus learn whether or not the desired combination has been selected from the display lamp **82** lit in the magnification paper selection panel section **78**. In case the desired combination has not been attained, it is possible to change the combination by again pressing the automatic paper/magnification selecting switch **109**.

The display panel section **79** is arranged to the right of the magnification paper selection panel section **78**. A pattern display **111** and a liquid crystal display **112** of the copying machine are arranged in the display panel section **79**. The pattern display **111** is used to display by means of lamps lit the feed tray selected and a location where jamming has occurred. A sentence including Chinese characters can be displayed on the liquid crystal display **112** of this embodiment. In the example shown in FIG. **5**, the copying machine is ready for operation with one set copy. The liquid crystal display **112** of this embodiment is a color liquid, crystal display which is able to indicate the specified areas with colors, respectively.

The following keys or buttons are disposed under the display panel section **79**:

(i) All clear button **114**;

This button is used to restore the basic state, i.e., to return the operational mode of the copying machine to the priority one initially set wherein copying paper is selected.

(ii) Ten keys **80**;

These keys are used to set the number of sheets of copying paper, input numerical values for specifying the contents of diagnosis when the copying machine is diagnosed.

(iii) Interruption button **115**;

This button is used in case of emergency where some other copies must be taken while continuous copy-making operations are performed. It is also used to release the interruption in order to restore the original copy-making operations as soon as the interruption process is terminated.

(iv) Stop-clear buttons **116**;

This button is used as a clear button to stop unfinished copy-making operations and to set the number of copies and the bin of the sorter.

(v) Start button **117**;

This button is used to start copy-making operations.

(vi) Selection key **118**;

This key is used to move a cursor in response to the message displayed, i.e., as a cursor key.

(vii) Set key **119**;

This key is used (as a return key) to locate the setting at the place specified by the cursor.

As set forth above, the basic operational area and the applicative operational area on the console panel in this embodiment are completely separated from each other; e.g., the selection of copying paper and copy density setting are carried out in the former, whereas the selection of functions and emphasis on monochromatic color are effected in the latter. In addition, errors in panel operation are minimized by giving assistance to the applicative operation by displaying Chinese characters including kana on the liquid crystal display **112**.

(4) Circuit configuration of copying machine.

FIG. **6** is a schematic circuit configuration of the copying machine (FIG. **2**).

In FIG. **6**, there is shown a decentralized CPU architecture for serial communication centering around a CPU **121** so as to make possible not only the optimum arrangement of a controller but also the provision of optimum cost performance. In view of the development of products such as copying machines, it is anticipated to shorten a period of developing software in the form of modules in design to improve the efficiency thereof, whereby it is ensured to simplify their wire furnaces, reduce production costs and to facilitate troubleshooting.

Since processing efficiency is increased by the decentralization of processing using a plurality of CPUs, programs prepared to the satisfaction of complicated high-speed processing can be provided using inexpensive 8-bit CPUs but not expensive 16-bit CPUs.

Moreover, the decentralization of processing facilitates the diffusion of models. In other words, even when new input/output devices are developed, the modification of programs on the part of the main CPU may become unnecessary, so that the alteration thereof is minimized.

With respect of the printed circuit boards on the main CPU side, the decentralization of the CPUs makes it unnecessary to store needless I/O ports and programs. Accordingly, it becomes possible to reduce the cost of the printed circuit board to ensure a free equipment layout.

The base machine **21** in this copying machine is controlled by a main CPU (Central Processing Unit) **121** and a CPU **122** for an inter-image lamp within the base machine **21**. The CPU **122** for an inter-image lamp in this case specializes in controlling the inter-image lamp.

The inter-image lamp is used to throw light on the photoreceptor drum **51** after exposure and to erase par of an electrostatic latent image before development. When an original of B5 size is copied equimultiplicably in the prior art, for instance, the area other than the B5 size on the photoreceptor drum **51** is illuminated so as to prevent a toner image from uselessly forming outside the area. The copying machine in this embodiment is, as will be described later, provided with the function of editing image too. When the formation of an electro-

static latent image may be restricted to a predetermined rectangular area or polygonal one, the partial deletion of the electrostatic latent image accordingly becomes needed to effect the aforesaid processing. In this case, a CPU independent of the main CPU **121** in the copying machine in this embodiment is employed because the inter image lamp is being used to an extent greater than that in the prior art.

Xerox Co. is one of the manufacturers that has introduced such a decentralized processing system as what is employed to control a copying machine and Japanese Patent Application (OPI) No. 78371/59 by Xerox Co. discloses the detailed contents of the art and relevant references in "Copying Machine Control Apparatus and Method of the Same."

The communication method adopted in the present invention is not the "Ether Network"" intended for high-speed processing employed in the aforesaid Patent Application but equivalent to what is capable of obtaining the same effect with a 4,800 Baud current loop.

In the meantime, the present applicaants have given a detailed description of the CPU **122** for an inter-image lamp in Japanese Utility Model Application No. 152591/86 entitle "Image Copying Machine" and Japanese Patent Application No. 023392/87 entitled "Image Erasing Device for Copying Machine."

In this embodiment, the copying machine is equipped with the following CPUs and connected with communication lines **123, 124**. The main CPU **121** assumes the role of generalizing those CPUs and the CPU **122** for an inter-image lamp.

(i) CPU **125** for feeding original;

A CPU **125** for feeding originals controls the DADF **24** shown in FIG. **4**. When the ADF **23** (FIG. **2**) in place of the DADF **24** is used, the CPU contained therein is connected to the communication lines **123, 124**.

(ii) CPU **126** for a sorter;

A CPU **126** is arranged in the 10-bin sorter **38**. Another CPU is also installed for special use in the 20-bin sorter **39**. The main CPU **121** finds out which one of the sorters **38, 39** has been connected and controls sorting correspondingly.

(iii) Display CPU **127**;

A display CPU **127 127** is used to display various kinds of data with kanjis on the aforesaid display **112** fitted to the console panel **28** and an area for editing purposes. No special CPU is used when the console panel **27** of a back lit type (FIG. **2**) is employed because complicated display control is unnecessary. If the liquid crystal display **112** is employed, the ten keys are used to designate figures being edited.

(iv) CPU **128** for controlling trays;

A CPU **128** for controlling trays is used to control the fourth and fifth trays **31-4, 31-5** among those newly added to the base machine **21**, the large capacity tray and the intermediate tray **33**. This CPU is located behind the tray cabinet containing each of the trays and controls them, depending on the tray thus connected. Among these trays, the intermediate tray **33** is equipped with its own motor for conveying copying paper and further the location of the copying paper placed on each tray differs with its size. Accordingly, the CPU needs to effect complicated control.

The mode of controlling each tray by the CPU **128** for controlling trays is as follows:

(i) Control of both or one of the fourth and fifth feed trays **31-4, 31-5** and the intermediate tray **33**;

(ii) Control of the large capacity tray and the intermediate tray;

(iii) Control of only the intermediate tray **33**;

(iv) Control of both or one of the fourth and fifth feed tray **31-4, 31-5**;

(v) Control of only the large capacity tray; and

(vi) CPU **129** for controlling cards.

The CPU **129** controls IC cards **131** used to store additional data for use in adding or correcting the functions of the copying machine in order that the data is read. When the IC card **131** is used to designate the coordinates of an original, further, the CPU **129** controls the reading/writing operation of the card **131**. Moreover, the CPU **129** can also control an editor pad **132**, though this operation is not employed in this embodiment. The editor pad **132** is used to input coordinates and will be described in detail later.

FIG. **7** is a detailed circuit configuration with the main CPU as a central figure acting the pivotal role in the copying machine of this embodiment.

Copying machines controlled by control apparatus such as CPUs and microcomputers have already been made known by a paper "A Programmable Digital Control System for Copying Machines" by Sikandar Sheikh of Xerox Co., IEEE Trans, Com, Vol IECI-21, No. 1, Feb. 1974 and Japanese Patent Application (OPI) No. 62644/75 "Electrophotographic Copying Process and Apparatus" as the first instance of a similar idea. Like the main CPU, other CPU modules are, needless to say, composed of one-chip CPUs, ROMs, RAMs, I/O, etc.

(i) The main CPU **121** is, as partially described in FIG. **6**, connected via the communication lines **123, 124** to the following component parts:

(1) DADF **24**.

(2) Sorter **38**.

(3) Liquid crystal display **112**.

(4) IC card editor pad interface **130**; an interference which is arranged in the IC card device **22** and causes data to be given to and received by the main CPU **121** when an IC card and an editor pad **132** are connected to the copying machine proper.

(5) Inter-image lamp controller **157**.

(6) Control unit for controlling the fourth and fifth trays **31-4, 31-5**, the intermediate tray **33**, etc.

(ii) The main CPU **121** incorporates an A/D converter and is connected via an analog data line **134** to the following parts. There are 8-bit one-chip CPUs, e.g., μPD7810CW, μPD7811CW of Nippon Electric Co. and MB89713X of Fujitsu, Ltd.

(1) Light quantity sensor **135**; used to detect the quantity of light derived from the exposure lamp **56** (FIG. **4**) and control it.

(2) Group of temperature sensors **136**; soft touch sensors for controlling fixing temperatures as will be descried later.

(3) Group of paper size sensors **137**; sensors for detecting the sizes of paper placed on the feed tray **31**. Copying paper can be fed from maximum five kinds of trays according to the system configuration of the copying machine in this embodiment. Consequently, if four sensors for detecting the paper size are disposed on one feed tray, with digital data being used for processing purposes, 4-bit digital data will have to be sent to the main CPU **121** from one tray. This will also necessitate maximum **20** input ports in total, together with a number of connectors and cables constituting a harness;

this construction is not preferable in view of not only cost and size reduction but also reliability.

In this embodiment, accordingly, the conditions specified by four sensors per tray of the copying machine are sent out as analog data. The analog data received by the main CPU **121** is converted into digital data therein, so that the maximum **16** sizes of copying paper put on each tray are identified.

(iii) Further, the main CPU **121** is reset at the time of the runaway or initialization of the reset circuit and also connected via a bus line **121***a* to the following parts.

(1) Keyboard/display LSI **121B**; circuit for interceding with the console panel **28** for the data.

(2) Timer/counter LSI **121C**; a circuit for controlling the driving of a main motor **164** and a carriage motor **171**.

(3) ROM **121D**; a Read Only Memory having a capacity of 56 K bytes and storing the basic control data of the copying machine.

(4) RAM **121E**; a Radom Access Memory having a capacity of 6 K bytes and temporarily strong data. The aforesaid nonvolatile memory (NVM) **121F** if connected to this RAM **121E** and capable of preserving the necessary data even when the power supply of the copying machine is cut off.

The necessary data stored in the nonvolatile memory (NVM) **121F** includes (a) a setup value for use in regulating the registration of copying paper, (b) the quantity of erasing the tip portion of an image by the inter-image lamp as will be described later in detail, (c) a fine adjusting value for use in adjusting the vertical and horizontal magnifications when the equimultiple copying value is set, (d) each parameter adjusting value for use in adjusting the parameter on the copying machine production line such as the quantity of a binding margin when a copy is taken with a blank for providing the binding margin, and (e) data for use in detecting the operating condition of the copying machine such as the actual value resulting from the use of the feed counter on each feed tray **31**. Moreover (f), a table of function data conversions between copying machines may be written to the nonvolatile memory, depending on the apparatus. In this case, the advantage is that the conversion table can be rewritten as occasion demands, using external data stored in IC cards.

(v) First I/O controller **121C**; an input/output controller for reading various data via a filter circuit **121H** and driving various parts via a driver circuit **121I**. Switches and sensors are connected to the filter circuit **121H** and solenoids such as developing solenoids and clutches **233** contained in the feed trays **31-1**~**31-5** are also connected thereto as will be described later.

(vi) Second I/O controller **121J**; an input/output controller for reading various data via a filter circuit **121K** and driving various parts via a driver circuit **121L**. Switches and sensors are connected to the filter circuit **121K**. The driver circuit **121L** is equipped with a know D/A (Digital-Analog) converter and a PWM (Pulse Width Modulator) and used to set the developing bias of a developing device and the current value of the charge corotron **52** as the program is processed, which will also be described later.

(5) Detailed circuit configuration of copying machine.

Referring to FIGS. **8**~**13**, a detailed description will be given of the circuit configuration of the copying machine in this embodiment.

(5-1) Periphery of photoreceptor drum.

FIG. **8** is a block diagram illustrating the periphery of the photoreceptor drum **51**.

On the periphery of the photoreceptor drum **51** are a charge corotron **52**, an inter-image lamp **141**, four kinds of sub-developing devices **59S1–59S4**, a main developing device **59M**, a transfer corotron **50**, a detack corotron **147**, a pre-clean corotron **148**, a cleaning device **149** and a deelectrifying erase lamp **155** in this order. The first, second, third and fourth sub-developing devices **59S1**, **59S2**, **59S3**, **59S4** use red, blue, green and light brown toner for developing, respectively.

The inter-image lamp **141** consists of a train of 128 light-emitting diodes disposed in a row and a plastic lens arranged in parallel with and in front of these diodes. The plastic lens (not shown) having a nonspherical convex surface in a position corresponding to each light-emitting diode is arranged so that, even when the light-emitting diodes adjacent to each other emit light, the intensity of the light on the photosensitizer drum **51** will not become uneven in the boundary therebetween. Moreover, the focal point of the plastic lens is made to shade off on the photoreceptor drum **51**. Accordingly, when a triangular figure is processed (e.g., extracted or deleted), for instance, the difference in stage between the light-emitting diodes as a unit is considerably decreased in the boundary being processed.

An inter-image controller **157** is designed to control the on/off of the light-emitting diodes as **128** segments of the inter-image lamp **141**. The cleaning device **149** is provided with a doctor blade **150** and used to peel the toner deelectrified by the pre-clean corotron **148** off the photosensitizer drum **51**.

In the copying machine in this embodiment, a main motor **164** is started 0.2 second later than the contact of the doctor blade with the photoreceptor drum **51**. Moreover, the doctor blade **150** is not separated from the photoreceptor drum **51** immediately after the main motor **164** stops but separated therefrom five seconds later; thereby the toner is prevented from contaminating the interior of the copying machine by scattering because of the vacuum suction strength.

The sub-developing devices **59S1–59S4** each are equipped with the following parts:

(i) Color sensor;

A color sensor for identifying which one of the color developing agents has been set in each of sub-developing devices **59S1–59S4**. Even if the sub-developing devices **59S** are installed with the combination of red, blue, green and light brown colors, the color sensors can be used to detect the respective colors provided for the sub-developing devices **59S1–59S4**. Each detection output is sent to a developing color detecting circuit **230** and transmitted to a main board **201**.

(ii) Toner sensor;

A toner sensor for determining whether the supply of toner is needed.

(iii) Dispense motor;

A motor for churning the toner contained in a toner box and supplying it.

A main developing device **59M** uses black toner for developing and has a toner sensor and the dispense motor. An ink lease switch **159**, if pressed by the operator, is used to increase the quantity of toner. While one of the sub-developing devices **59S1–59S4** is selected, the ink lease switch **159**, if pressed, operates to increase the quantity of toner being suppled to the sub-develop-

ing device involved. If the switch is pressed while the main developing device **59M** is selected, the quantity of black toner is increased.

A developing device selecting solenoid **161** is used to selectively switch the five developing devices, namely, the main developing device **59M** and the sub-developing devices **59S1–59S4**. The switching operation will be described anew in the subsequent paragraph.

A high-voltage power supply (HVPS) **162** is used to form a parallel electric field in the main and sub-developing devices **59M, 59S1–59S4** so as to improve the reproducibility of the solid portion (solid black one). A full toner sensor **163** is used to detect whether the toner has been recovered satisfactorily to a toner recovery container. The main motor **164** is used to drive the photoreceptor drum **51**, a heat roll **66** or a conveyer system from the matching (registration) of timing at which the copying paper **60** is conveyed up to the discharging time.

(5-2) Switching mechanism of developing device.

FIG. **9** is a waveform chart illustrating the switching timing of the main developing device and the sub-developing devices of this embodiment. The waveform chart exemplifies red color developing first carried out in the first developing device **59S1** and monochromatic developing secondly made in the main developing device. When the start button **117** (FIG. **5**) of the copying machine is pressed in order to start copy-making operations, the main motor **164** is driven from time t_1 as shown in FIG. **9**(*a*). The main motor **164** is being continuously driven up to t_3, when the copy-making operations are completed in both two developing devices **59S1, 59M.**

FIG. **9**(*b*) represents the drive timing of the developing device selecting solenoid **161**. The developing device selecting solenoid **161** is kept excited until red copy-making operations by the first sub-developing device **S1** are transmitted. A lever abuts against the peripheral face of a clutch (not shown) because of the excitation of the developing device selecting solenoid **161** in this copying machine. On receiving the driving force from the main motor **164**, the clutch shifts by 72 degree at a time and starts the rotation of five sets of cams (not shown), each having a protrusion. When one of the protrusions abuts against the first sub-developing device **S1**, it presses the first sub-developing device **59S1** toward the photoreceptor drum **51**. The protrusions of the remaining cams are left most apart from the main developing device **59M** and the other sub-developing devices **59S2–59S4**, and the main developing device **59M** and the other sub-developing devices **59S2–59S4** remain most apart from the photoreceptor drum **51**.

There are five protrusions disposed on the periphery of the clutch and, when the lever abuts against the protrusion involved, the protrusion corresponding to the one cam is most strongly pressed against the first sub-developing device **59S1**. Development with red color toner is made in that position. However, since the main developing device **59M** in the initial state is arranged close to the photoreceptor drum **51** in this copying machine, the red color development is not started immediately at t_1 but kept on standby by one second. At this time, the aforesaid cam sets, in place of the main developing device **59M**, the first sub-developing device **9M**, the first sub-developing device **59S1** (or the other sub-developing devices **59S2–59S4**) to the photoreceptor drum **51.**

When the first sub-developing device **59S1** has completed the copy-making operations, the aforesaid five cams move to have the protrusion of the monochromatic cam positioned by the lever, whereas the main developing device **59M** is set to the photoreceptor drum **51** for one second after t_2. Then the monochromatic developing is carried out.

What has been described above refers to only red color marking but, when marking with a plurality of colors is made, one of the sub-developing devices **59S1–59S4** is successively selected in predetermined order as what is involved and the monochromatic developing is made after the completion of the operation above.

FIG. **10** refers, by way of example, to a case where the monochromatic developing is first made and subsequently followed by red color development. FIGS. **10**(*a*) and **10**(*b*) are graphic presentations respectively illustrating the operation of the main motor **164** and the developing device selecting solenoid **161**. In the case of FIG. **10**, development is first carried out by the main developing device **59M** and therefore one second of standby time is unnecessary at that point of time. However, one second has to be secured after the completion of the monochromatic development as the second one and the main developing device **59M** has to be set again to the photoreceptor drum **51.**

(5-3) Optical system.

Referring to FIG. **11**, an optical system will subsequently be described.

A carriage (not shown) provided with the lens and mirrors is reciprocally operated by a carriage motor **171**. The carriage motor **171** includes a step motor and the position of the carriage returning to the home position is controlled by a registration sensor **172.**

The registration sensor **172** is used to set the timing at which the optical system and the conveyance of the copying paper **60** is adjusted. In other wards, the carriage is provided with an actuator for intercepting the transmission of light and, as the carriage moves, the registration sensor **172** detects the temporary interruption of the light rays. The signal detected thereby is used to determine the position or timing for implementing the registration or to determine the home position at the time the carriage is returned.

A density control sensor **173** is used to control the copy density of an original. As set forth above, the copying machine in this embodiment is so designed as to control the copy density by simultaneously adjusting the charge quantity given to the photoreceptor drum **51**, the image exposure quantity and the developing electrode bias. A lens mirror sensor **174** controls the movement of the optical lens **58** and the mirrors **57** (FIG. **4**) and consists of one detecting element. A lens mirror motor **175** has also been redesigned to simultaneously drive the lens **64**, the mirror **57** and the like that are separately driven in the conventional copying machine. The exposure lamp **56** has already been described. A fan **177** for the optical system is used to air-cool part of the optical system in order to remove heat from the platen glass plate **55.** An original sensor **178** is used to detect the size of an original.

(5-4) Fixing device.

The relation of a fixing device to the others will subsequently be described by reference to FIG. **12**.

The base machine **21** in this embodiment is provided with a main fuser lamp **181** and a sub-fuser lamp **182**, i.e., two kinds of fuser lamps within the heat roll **66**. The sub-fuser lamp **182** is shorter than the main fuser lamp **181** and slightly deviated from one end of the main fuser lamp **181**. In this embodiment, the so-called corner registration method is employed, wherein the copying paper **60** in this copying machine is aligned with one side of the platen glass plate **55**, whereby the required quantity of heat energy in the axial direction of the heat roll **66** differs with the size of copying paper **60** for use. In order to correct the deviation of the temperature distribution in the axial direction caused thereby, the power suppled to the sub-fuser lamp **182** is controlled, depending on the size of copying paper **60**. The adoption of the sub-fuser lamp **182** makes it possible to satisfactorily prevent temperature variations in the fixing device.

A fuser outlet sensor **184** and an STS (Soft Touch Sensor) **185** both are connected to the fixing device. The fuser outlet sensor **184** is employed to detect whether the copying paper is discharged on the discharge tray without being rolled in between both the rolls **66**, **67** after it is passed between the heat roll **66** and the pressure roll **67**. The S.T.S **165** is the temperature sensor of the fuser lamps **181**, **182**.

(5-5) Control of console.

Referring to FIG. **11** again, the control of the console will be described

A console control unit **191** is provided with a message ROM **192** for displaying messages in kanjis. The IC card device (IC card reader/writer) **22** for reading and writing the IC card **131** (FIG. **6**) and connecting the editor pad **132** (FIG. **6**) via an interface board **193** can be connected thereto The IC card device is, as described above, controlled by the card CPU **129** (FIG. **6**). The console control unit **191** is connected to a main board **201** with the aforesaid main CPU **121** mounted thereon.

(5-6) Billing counter.

Referring to FIG. **12**, a description will be given of a billing counter for use in collecting copying charges.

As the base machine **21** in this embodiment is capable of making copies in five colors, two kinds of billing counters are installed. A main billing counter **211** counts the number of copies taken, irrespective of the color. The values counted by the main billing counter **211** are employed as data for use in controlling counts even when accessories **212** such as a coin kit and a key counter are fitted to this copying machine. A sub-billing counter **213** is used to count the sum of the number of colors used for each color copy taken.

(5-7) Power supply.

Referring to FIG. **12**, a power supply will be described.

The base machine **21** is connected to a commercial 100 V power supply. As to those put in overseas markets, it has been arranged that they can be connected to a 115V/60 Hz or 220 V/50 Hz power supply. The power supplyed via a plug socket is given to a main switch **224** through a circuit breaker **222** and a noise filter **223**. The power is then suppled form the output of the main switch **224** via an interlock switch **225** to an AC driver **226**, a fixing control element **227** and a DC power supply **228**. Further, the power is suppled to the DADF **24** and the intermediate tray **33** too.

The AC driver **226** supplies the power to the following parts at predetermined timing.

(i) Deelectrifying erase lamp **155** (FIG. **8**).

(ii) exposure lamp **56** and a fan for an optical system (FIG. **11**).

(iii) Main fuser lamp **181** and the sub-fuser lamp **182** (FIG. **12**).

The DC power supply **228** supplies to the following parts at predetermined timing:

(1) Interlock switch **225** (FIG. **12**).

(2) AC driver **226** (FIG. **12**).

(3) High-voltage power supply device **162** (FIG. **8**).

(4) Sorter **38** (FIG. **12**).

(5) Fuser outlet sensor **184** (FIG. **12**).

(6) Element **227** for controlling fixation (FIG. **12**).

(7) Accessories **212** (FIG. **12**).

Accessories includes a coin kit for having copies taken using, e.g., coins and a key counter for controlling copying-making operations in each section.

(8) Main billing counter **211** and a sub-billing counter **213** (FIG. **12**).

(9) X-port fan (FIG. **12**); a vacuum fan for sucking the copying paper conveyed in a conveyer passage called an X-port.

(10) Inter-image lamp controller **157** (FIG. **8**).

(11) Carriage motor **171** (FIG. **11**).

(12) Registration sensor **172**, density control sensor **173**, lens mirror sensor **174** and mirror motor **175** (FIG. **11**).

(13) Original sensor **178** (FIG. **11**).

(14) Ink lease switch **159**, air detecting sensors of sub-developing devices **59S1–59S4** and main developing device **59M** and development selecting solenoid **161** (FIG. **8**).

(15) Main board **201** (FIG. **8**, etc.).

(5-8) Conveyer system.

Referring to FIG. **13**, a conveyer system for conveying copying paper will be described.

The first-fifth feed trays **31-1**~**31-5** are provided with no-paper sensors **231**, size sensors **232** and clurches **233**, respectively. The no-paper sensors **231** are used to detect the presence or absence of copying paper on the feed trays **31-1**~**31-5**. Copying paper of the same size can be set on the plurality of feed trays in this copying machine and copying paper of the same size is automatically suppled from another feed tray when no copying paper is present on one of the feed trays. The size sensor **232** is used to identify the size of copying paper placed on the tray. The clutch **233** is a component part for controlling the on/off state of each of the feed rolls **61-1**, **61-2** . . . being driven.

Copying paper is fed by a feed motor **235** for special use in feeding the paper. A step-motor is used as the feed motor **235**. A feed sensor **236** detects whether copying paper is being properly conveyed. A gate solenoid **237** is used to true up the front edges of sheets of copying paper sent out once. The gate solenoid **237** is different from an ordinary type and used to control copying paper in such a manner that the paper is passed as it opens when energized.

More specifically, power is not suppled to the gate solenoid **237** in the standby state in which no copying

paper arrives thereat and the gate is kept open. Power is then suppled to the gate solenoid **237** slightly before the arrival of copying paper and the gate is shut to check the passage of the copying paper. The gate solenoid **237** is subsequently deenergized and opened at the point of time the copying paper is conveyed again at the predetermined timing. The gate solenoid **237** is so controlled that its position less fluctuates at the point of time the front edge of copying paper is held in check. The copying paper is thus accurately positioned even while it is relatively strongly pressed against the gate solenoid **237**.

A manual insertion switching solenoid **238** is used to switch the driving of a carrier roller for conveying copying paper sent out from the first feed tray **31-1** and a carrier roller for conveying copying paper manually fed from the tray **41** for manual insertion. A manual insertion tray sensor **239** detects the presence of copying paper when sheets of copying paper are fed from the tray **41** for manual insertion. A tray interlock switch **241** is fitted to a mechanism operated to remove the copying paper jammed. A tray pass sensor **242** detects the copying paper **60** supplied from the second and third feed trays **31-2, 31-3** and arranged near the connections of the base machine **21** and the respective feed trays **31-2, 31-3**.

(5-9) DADF.

Referring to FIG. **14**, the DADF .**24** will be described in detail.

The DADF **24** is mounted on the platen glass plate **55** of the base machine **21** and provided with an original tray **252** on which originals **251** are placed. Originals **251** are piled on the original tray **252** in such a manner that the first side of each from which a copy is taken faces down.

A return pad **254** and a feed paddle **255** are disposed on one side of the original tray **252** from which originals **251** are sent out one after another. The original **251** thus fed is moved by a driving roller **256** and a driven roller **257** and passed through an S-shaped conveyer **258** before being pressed against a branch guide **261** arranged in the position where the S-shaped conveyer **258** and a vertical conveyer **259** intersect. The branch guide **261** is opened thereby and the original **251** is sent to an inverted conveyer **262**.

When the rear end of the original **251** passes through the branch guide **261**, the branch guide **261** is stopped on the S-shaped conveyer **258** side because of the action of a spring (not shown). Then the passage of the original **251** is detected by a sensor (not shown) arranged close to the branch guide **261**. A driving roller **264** for inverting the original responds to the detection signal output and turns inversely. As a result, the direction in which the original **251** is conveyed is inverted and changed to what is roughly perpendicular to the platen glass plate **55**.

The original **251** is being conveyed while one side of the original abuts against a side positioning guide (not shown) because of an oblique slip paddle **265** and thus adequately positioned. The original is further carried by an endless conveyer belt **266** up to a proper position on the platen glass plate **55**. In this manner, a copy of the first side of the original **251** is taken.

After the completion of exposure of the first side, the original **251** is conveyed by the endless conveyor belt **266** in direction of arrow **267**. When one side only is coupled, a vertical conveyer **269** is selected by a guide on the outlet side and the original **251** is received by an original receiving part **271**.

If the second side opposite to the first one is copied, a horizontal conveyer **272** is selected. The original **251** fed onto the horizontal conveyer **272** is conveyed by a carrier roller **273** in the direction opposite to the arrow **267** and further conveyed by the driving roller **256** and the driven roller **257** to the S-shaped conveyer **258**. At this time, the underside of the original **251** is the second side which is opposite to the first side of the original placed on the original tray **252**. Accordingly, the second side is copied when the original **251** is sent to the platen glass plate **55**.

The original **251** is sent to the vertical conveyer **269** by the action of the guide **268** on the outlet side after the exposure of the second side and discharged onto the original receiving part **271**.

(5-10) Sorter.

Referring to FIG. **15**, the 10-bin sorter **38** will be described in detail.

FIG. **15** is an external view of the sorter. The 10-bin sorter **38** is constructed so that 10 sheets of bins **281** are integrally moved up and down. The sorter proper **282** consists of a driving source (bin motor) for moving them up and down, a cam and a cam switch for controlling the movement of each bin, and a down limit switch (both not shown) for detecting the arrival of the bins **281** at the lowest limit position.

Copying paper **60** is moved by the carrier rolls **68, 68** shown in FIG. **4** in direction of arrow **284** and fed into the sorter proper **282** and, at this point of time, discharged onto the bins located opposite to the conveyer passage. Some sorters are designed to switch the discharge passage by not moving the bins **281** but the sorter proper **282**. Mode selection in the sorter **38** is effected by operating the panel **74** for a sorter shown in FIG. **5**.

(5-11) Editor pad.

Referring to FIGS. **16** and **17**, an editor pad **132** will be described in detail.

FIG. **16** shows the system configuration of a copying machine with an editor pad. More specifically, because the copying machine embodying the present invention is equipped with the DADF **24** mounted on the platen glass plate **55** as shown in FIG. **3**, the platen **26** with an editor pad cannot be mounted thereon.

In the copying machine shown in FIG. **16**, the platen **26** with the editor pad is mounted on the base machine **21** equipped with the first feed tray **31-1**. The editor pad **132** is located in a square portion in FIG. **16**. This copying machine is provided with a back lit type console panel. Moreover, a cabinet **401** containing only the second and third feed trays **31-2, 31-3** is arranged under the base machine **21**. The base machine **21** is fitted with no sorter and the discharge tray **37** for receiving the discharged copying paper is installed.

As to the general construction of the copying machine, see FIG. **2**. The editor pad **132** is extremely convenient for an coordinate input and usable as an independent unit for the copying machine shown in FIG. **3** as an embodiment of the present invention. In this case, the editor pad **132** may be placed on a desk or the like and directly connected to the IC card device **22** (FIG. **3**) with a cord or coordinate data may be written to the IC card **131**, which is then mounted on the IC card device **22** for use.

FIG. **17** illustrates the construction of the editor pad. The editor pad **132** is provided with a rectangular coordinate input pad **405** which is 307 mm long and 432 mm wide. An area 10 mm wide on this side of the pad is employed as an editor panel **406**. The editor pad **132** including the editor panel **406** is such that a first rubber pad with a resistance wire for designating a position on the abscissa and a second rubber pad with a resistance wire for designating a position on the ordinate are superposed with a spacer sandwiched therebetween. The position pressed by the finger of the operator or tip of a pen is sensed in the form of values on the abscisa and ordinate. On this side of the editor panel **406** is a display panel **407** for displaying various kinds of data. Moreover, a circuit board for processing coordinate data and a circuit board **408** for an interface circuit are disposed in the rear portion of the editor pad **132**.

FIG. **18** shows the editor panel illustrated in FIG. **17** and the principal part of the display panel. The following buttons are disposed on the editor panel **406**:

(i) Special function button **411** for use when special functions are employed.

(ii) Button **412** for dimensional alteration and redoubling: used to specify contraction/magnification by designating distances.

(iii) Extraction button **413** for extracting the area specified: used for monochromatic recording.

(iv) Deletion button **414** for deleting the area specified: also used for monochromatic recording.

(v) Continuous copying color dualizing button **415**, which is a function button for designating the continuous copying color dualizing function.

(vi) Color marking button **416**, which is a function button for specifying the color marking function.

(vii) Partial color conversion button **417** used to specify the function of partially converting color.

(viii) Color inversion button **418** used to convert the area specified as color to black and the area specified as black to color. The continuous color dualizing button **415**, the color marking button **416**, partial color conversion button **417** and the color inversion button **418** are all function buttons for color recording.

(ix) Designation method button **419** used to choose whether an area is specified with the coordinates of two points at both ends of a diagonal line of a rectangle or the coordinates of each point of a polygon.

(x) Area color designation button **421** used when an area is specified.

(xi) Area clear button **422** used to release the designation of an area.

(xii) Setting termination button **423** used when the designation of one or a plurality of areas is completed.

To the display panel corresponding to the first 8 buttons **411–418** are attached display lamps **425** for displaying whether the respective 8 buttons **411–418** have been selected. As for the designation method button **419**, a diagonal designation lamp **426** or a polygon designation lamp **427** is lit, depending on the designation selected.

(xiii) Normal marking button **431** used to specify the normal marking form for uniformly marking an area; e.g., marking a rectangular area.

(xiv) Side marking button **432** used to mark, e.g., the specified area enclosed with a frame.

(xv) Line marking button **433** used to mark, e.g., the specified area like a thick underline

(xvi) Color designation buttons **434–437** for specifying a color relative to a marking area because the marking color can be determined independently on an area basis. In this case, the color designation button **435** is used to specify red and the color designation button **435** to specify blue. The color designation button **436** is employed to specify green and the color designation button **437** to specify light brown. As set forth above, the copying machine in this embodiment permits colors other then the above-described ones to be set and, in this case, top covers attached to the surface of the color designation buttons **434–437** will have to be replaced with desired ones, respectively. Display lamps **438** are annexed to the buttons **431–437** for special use in marking, which have been described in (xiii)–(xvi), respectively, in order to display which one of the lamps has been selected.

(6) Paper tray control system.

(6-1) Paper tray.

In the copying machine involved in the present invention, the first to third supply trays **31-1**~**31-3** are fitted to the base machine. However, the intermediate tray **33**, the forth tray **31-4**, the fifth tray **31-5** and the large capacity tray **471**, together with the DADF **24** and the IC card device **22**, etc., are arranged as additional devices attachable as options when the users so desire. Moreover, the paper trays as the additional devices in this copying machine can selectively be added with the combinations described in FIG. **2**, whereby the control of the paper trays corresponding to the respective combinations becomes required.

Particularly, the mechanism of the intermediate tray **33** is needless to say quite complicated in that it has various functions different from those of other paper trays and therefore needs complicated control. If the intermediate tray **33** is attached, for instance, the paper used for copying can be restored thereon and besides it can be set upside down or with its surface usable as a copying side again. In other wards, the intermediate tray **33** is the duplex-dual tray module (DDM) for use in taking a copy again, which consists of two modes: the duplex mode and the dual mode. The mode switching is effectuated at the console panel. The usable function of the intermediate tray **33** varies with whether or not the DADF **234** has been added. Only the presence of the DADF **24**, for instance makes usable the duplex original-one-side copying function but not the duplex original-duplex copying function. When the intermediate tray **33** is added, however, the sheet dualizing, parallel dualizing, color marking, continuous copying color dualizing, partial color converting functions, etc., so say nothing of the duplex original-duplex copying and one-side original-duplex copying ones become usable.

The sheet dualizing in the editing function is such that both the first and second originals as a whole are superposed and recorded on one sheet of copying paper. In the copying machine in this embodiment, up to five areas on the first original can be designated and further copies of the first and second originals can be taken in different colors respectively using different monochromatic color switches **91**. On the other hand, the parallel dualizing function is employed to the whole of the second original is attached to that of the first original in order to make a dual copy of them on one sheet of copying paper. The original is sent out of the ADF **23**

or DADF **24**. The parallel dualizing function is unusable in a copying machine equipped with none of them. If the switch **88** is pressed to designate an area where marking is provided, recording is carried out with thin color superposed thereon so that it looks as if it were provided with the marking. In the case of the continuous copying color dualizing function, it is employed to record one color in the designated area of a copy, wherein a figure to be expressed is place, e.g., to the right of the platen glass plate **55** and an original to the left thereof while the switch **90** is pressed. When a copy of the original is taken in that state, the image data thereof is copied in black and a monochromatic figure is drawn thereon. With the partial color converting function, the switch **89** is pressed to designate an area, which is copied monochromatically, the remaining portion being copied in black.

If the control software is loaded on the copying machine proper, with the DADF **24** and other additional devices added to make it multifunctional, the paper trays have to be controlled variably in conformity with the functions selected. However, the present invention contrives to make it unnecessary to change the control system on the part of the base machine even though the intermediate tray and other paper trays are added or otherwise the arrangement of them is altered but to flexible deal with such a situation by means of device. More specifically, the main controller means having the main CPU **121** and the tray controller means having the CPU **128** for controlling trays are connected by the communication lines **123**, **124** and the tray controller operates to control the paper tray added under the control of the main controller through serial communication.

(6-2) Outline of paper tray control system in general.

FIG. **19** is a schematic block diagram of an overall paper tray control system.

In FIG. **19**, there is shown a main controller **501** comprising the main CPU **121**, the ROM **121D**, the RAM **121E**, the I/O controllers **121J**, **121G**, etc. as described with reference to FIG. **7**, the main controller **501** being connected via the serial lines **123**, **124** to a controller **502** for controlling trays Control and status data is exchanged between the main controller **501** and a tray controller **502** through serial communication. The tray controller **502** comprises a tray control CPU **128**, a ROM **503**, a RAM **504**, an output port **505**, an input port **506**, connectors **507**, etc., whereas modules motors of the DDM (intermediate tray), FTM (fifth tray) and HCF (large capacity tray) as additional devices, solenoids and various sensors for detecting jamming and the status of other paper trays are connected to the connectors **507**, which detect the presence or absence of the modules and transmit the respective signal detected to the main controller **501** via the serial lines **123**, **124**.

(6-3) Serial communication system.

FIG. **20** is a serial communication timing chart; FIG. **21** is a diagram illustrating the structure of serial communication data exchanged between the main controller and the tray controller; FIG. **22** is a diagram explanatory of a serial reception signal; and FIG. **23** is a diagram explanatory of a serial transmission signal.

As described with reference to FIG. **6**, the communication lines **123**, **124** connect the main CPU **121** of the main controller **501** and the tray control CPU **128** of the tray controller **502**. The serial communication is carried out via the communication lines **123**, **124** with timing at which transmission and reception are made in the order shown in FIG. **20** with a period of 100 msec. As shown in TX, 4-byte data, 5-byte data and 9-byte data are respectively transmitted from the main CPU **121** via the serial line **123** to the sorter CPU **126**, to the original feed CPU **125** and the tray control CPU **128** and to the display CPU **127**. Upon receiving the data, each CPU returns the data having the bit structure shown in RX via the serial line **124** to the main CPU **121** at the timing shown therein.

The signal received by the tray controller from the main controller consists of, e.g., an X'C**5**' control word, SERL#IN**1** of one shot data, SERL#IN**2**, SERL#IN**3** of level data and a check code BCC shown in FIG. **21**(*a*), whereas the signal transmitted by the tray controller to the main controller consists of an X'C**6**' control word, SERL#OUT**1**~**4** of level data and a check code BCC shown in FIG. **21**(*b*).

(i) Signal received by the tray controller.

The SERL#IN**1** of one shot data consists of data shown in FIG. **22**(*a*) and DREG#ON, for instance, is set immediately after the register gate of the machine body is turned on, provided it is thus set only in the intermediate tray stock mode, whereas the DUPL# FON is set when paper is fed from the intermediate tray. HCF#ON is set when paper is fed from the large capacity tray, whereas **5**TRAY#FON (**4**TRAY#FON) is set when paper is fed from the fifth supply tray **31-5** (fourth supply tray **31-4**). INCH#MOD is used when the serial communication is initially made as data for sorting paper size into inch/AB series. The SERL#IN**1** of one shot data is set in the main controller under those conditions.

The SERL#IN**2** of level data consists of data shown in FIG. **22**(*b*) and MOT#ON, for instance, is set immediately after a main motor **164** is turned on and cleared immediately after the main motor is turned off. COPY@MOD is data indicating (DUPLEX NORMAL), (DUPLEX CONTINUOUS PAGINATION) and other modes, whereas PAPR@SIZ is data indicating paper size.

The SERL#IN**3** of level data consists of data shown in FIG. **22**(*c*) and DUPL@QTY, for instance, is data indicating the number of sheets of paper accommodated on the intermediate tray, whereas PHND#ILK is data set when the right side panel is opened.

Moreover, (DIAG) is data for self-diagnosis.

(ii) Signal transmitted from the tray controller.

SERL¥OUT**1** of level data consists of data shown in FIG. **23**(*a*) and DFLT@COD, for instance, is data indicating jam timer setting data, whereas OPTN@-SEL is data for selecting options such as (DDM M/C) and (HCF M/C).

SERL¥OUT**2** of level data consists of data shown in FIG. **23**(*b*) and DDM¥LILK, for instance, is turned on when the left side interlock of the intermediate tray is opened and DDM¥DRV is turned on/off synchronously with the DDM drive motor **361**, whereas C**6**¥-JAM is turned on when C**6-1**JAM occurs. Moreover, DTRAY¥OK is turned on when the intermediate tray setting up is completed in its feed mode, whereas DDM¥TILK is turned on when the tray interlock of the intermediate tray is opened.

SERL¥OUT3 of level data consists of data shown in FIG. **23**(*c*) and HCF@SIZ and 4TRAY@SIZ, for instance, are data indicating paper size and setting up conditions. C7YJAM is turned on when C7-1JAM occurs, whereas DFHYJAM is turned on when C8-2JAM occurs.

SERL¥OUT4 of level data consists of data shown in FIG. **23**(*d*) and HCF¥RDY, for instance, is turned on when the large capacity tray is ready and HCF¥1LK is turned on when the interlock of the large capacity tray is opened, whereas HCF¥NOP is turned when no paper is present on the large capacity tray.

(6-4) Intermediate tray control system.

FIG. **24** is a diagram illustrating an intermediate tray control system configuration and FIG. **25** is a schematic view of a conveyer system centering around the intermediate tray.

FIG. **24** is a block diagram illustrating the intermediate tray (DDM) portion in the paper tray control system shown in FIG. **19**. As described above, the intermediate tray control system controls the intermediate tray **33** by means of the tray controller **502** having the tray control CPU **128** and connected via the communication lines **123** and **124** to the main controller (FIG. **7**) having the main CPU **121** on the base machine side. Simple signals are exchanged through serial communication between the controller **501** for controlling the machine body (base machine) and the controller **502** for controlling the intermediate tray so as to control duplex/dual copying paper. For this purpose, the sensors and driving mechanisms are connected to the input and output ports of the tray controller **502** respectively as shown in FIG. **24**, and FIG. **25** is a schematic diagram of the intermediate tray with an arrangement of them.

Referring to FIG. **25**, the intermediate tray **33** will subsequently be described.

The copying paper **60** thermally fixed by the heat roll **66** in the base machine **21** is controlled so that it is moved by the DDM gate solenoid also disposed in the base machine **21** toward the discharge tray or sent toward the intermediate tray **33**. A first DDM inverter sensor **352** is disposed on the base machine **21** side and a second DDM inverter sensor **353** is arranged near the second supply tray **31-2**. Both the sensors detect whether the copying paper **60** has jammed before it reaches the proximity of the intermediate tray.

However, the intermediate tray **33** locks in a feed roll for feeding the front end of the copying paper **60** up to the front end of the tray. Accordingly, three DDM tray-in solenoids **355–357** for use in conveying the copying paper **60** thus fed up to a desired position, depending on its size, and "dropping" onto the tray. These tray-in solenoids **355–357** are selectively operated according to the size of the paper thus fed to switch on/off the corresponding gate. A DDM measure roll solenoid **358** is a gate for controlling the copying paper **60** thus dropped so that an angle of its front end abuts against an angle of the front end of the intermediate tray **33** and for aligning the front ends of the copying paper thus fed one after another. The main billing counter **211** is incremented by one each time the operation of aligning one sheet of the copying paper is completed.

As set forth above, the intermediate tray **33** is controlled by the tray control CPU **128** and conveys the copying paper under the control of the DDM drive motor **361**. A DDM no-paper sensor **362** is used to detect the presence or absence of the copying paper **60** on the intermediate tray **33**. A DDM feed clutch **363** is a mechanism for controlling the on/off operation of the driving source for sending out the copying paper **60**.

A DDM inverter solenoid **364** is used to switch the operation of taking a duplex copy to that of marking one and the same side with a plurality of colors or taking a dual copy. When the DDM inverter solenoid **364** is positioned in the direction shown in FIG. **25**, the copying paper **60** conveyed so as to drop downwardly along the conveyor passage **365** is guided and dropped by the DDM inverter solenoid **364** before being upwardly conveyed by the conveyer roll **368**. The direction in which the copying paper **60** has been conveyed is changed to the right one in FIG. **25** before the DDM inverter solenoid **364** and stored upside down on the intermediate tray **33**. When conveyance is restarted in that situation, a duplex copy is taken.

When the copying paper **60** that has been conveyed downwardly is turned right before the DDM inverter solenoid **364**, the copying paper **60** is stored with it surface side remaining turned-up. When conveyance is restarted in that condition, the same side is used for copying again. When N kinds of colors are employed for marking, one sheet of copying paper **60** is stored on the intermediate tray N times and monochromatically developed before being discharged.

A D/F/H sensor is used to count the number of sheets of payer sent out of each module.

(6-5) Operational timing of intermediate tray module.

FIG. **26** is a diagram exemplifying the operational timing of an intermediate tray module and the operational timing will subsequently be described.

(1) On receiving an MOT#ON signal, the DDM side enters the RUN mode and is set in a DREG#ON standby state.

(2) On receiving a DREG#ON signal, the timer is started to turn on the DDM gate solenoid **351** and the DDM drive motor **361** a predetermined time later so as to set the position of the side guide **381** by the size received of the PAPR@SIZ.

(3) A DDM#DRV signal is turned on when the DDM drive motor **361** is turned on in order to inform the base machine of the fact that the DDM is in operation.

(4) Which one of the two, duplex of dual copy, is determined with the COPY@MOD transmitted from the base machine then and the DDM is controlled by the sensors and the solenoids on the DDM side and the set number of sheets received of the DUPL@QTY. A DDM¥BILG signal is then turned on each time paper is completely accommodated on the DDM tray and simultaneously the billing counter **211** on the machine side is incremented by one.

(5) When the number of sheets stored on the DDM tray conforms to the set number of sheets received of the DUAL@QTY, the DDM drive motor **361** is stopped and the DDM¥DRV signal is turned off in order to effected the feed mode for taking the paper out of the DDM tray.

(6) Simultaneously with the interruption of the operation of the base machine, the MOT#ON signal is turned off and, on detecting the off state, the DDM side enters the standby mode.

(7) On receiving the MOT#ON signal again, the DDM signal enters the RUN mode and sets the

DDM tray capable of being fed. Simultaneously, the DDM¥DRIV is turned on.

(8) When DDM tray becomes capable of being fed, a DTRAY¥OK signal is turned on and a DUPL# FON standby state is brought about.

(9) On receiving the DUPL#FON, feeding from the DDM starts.

(10) After the set number of sheets received of the DUAL@QTY is fed, the DDM drive motor **361** is stopped and the DDM¥DRIV and DTRY¥OK signals are turned off.

(11) Simultaneously with the interruption of the operation of the base machine, the MOT#ON signal is turned off and, on detecting the interruption, the DDM side enters the standby mode.

(6-6) Other paper tray control system and its operational timing.

In the copying machine concerned in the present invention, the large capacity tray **471** or fourth and fifth supply tray **31-4, 31-5** instead may be set as set forth above. FIG. **27** is a diagram exemplifying a fourth-fifth supply tray control system configuration. FIG. **30** is a schematic block diagram of a paper supply means equipped with the fourth and fifth supply trays. FIG. **28** is a diagram exemplifying a large capacity tray control system configuration. FIG. **29** is a schematic block diagram of a paper supply means equipped with the intermediate tray and the large capacity tray as additional devices.

1,000–2,000 sheets of copying paper can be set in the large capacity tray **471** at a time and a large quantity of copies can also be taken without interruption. The large capacity tray **471** and the fourth and fifth supply trays **31-4, 31-5** are equipped with circuit parts shown in FIG. **30**. Principle parts are as follows:

(i) Elevator bottom sensor **472**.

This sensor is used to detect a lower limit position of the large capacity tray **471** equipped with an elevator mechanism for moving the copying paper **60** up and down.

(ii) Interlock switch **473**.

This switch is used to detect the opening and closing of a front panel of the large capacity tray **471**.

(iii) No-paper sensors **474** and **474'**.

This sensor is used to detect that the copying paper **60** stored is running short.

(iv) Size sensors **475** and **475'**.

This sensor is used to detect the size of the copying paper **60**.

(v) Tray motors **476** and **476'**.

This motor is used to drive the elevator mechanism of each tray in order to move up and down a portion of the tray where the copying paper **60** is stored and to feed the paper.

(vi) Set sensor **477**.

This sensor is used to detect an upper limit position of the large capacity tray equipped with the elevator mechanism.

(vii) Feed clutches **478** and **478'**.

This clutch is used to control copying paper feeding.

(viii) Feed sensors **479** and **479'**.

This sensor is used to detect the jamming of the copying paper **60** sent out of the tray.

The large capacity tray **471** is supplied with a.c. power from the output of the noise filter **223** shown in FIG. **8** and d.c. power from the d.c. power supply **228** via the main board **201** also shown in FIG. **8** to operate those circuit parts.

The operational timing of the control system will subsequently be described. FIG. **31** is a diagram exemplifying the operational timing of the fourth and fifth supply trays. FIG. **32** is a diagram exemplifying the operational timing of the large capacity tray.

In connection with the operation of the fourth and fifth supply trays (FTM), the size of paper inserted onto the fourth and fifth supply trays is detected (**4**TRYS@-SIZ, **5**TRY@SIZ) while the power is being supplied and transmitted to the base machine. On receiving the MOT#ON signal, the FTM side enters the run mode and is placed in a **4**TRY#ON or **5**TRY#ON signal standby state. On receiving the **4**TRY#ON or **5**TRY-#ON signal, the FTM side starts feeding paper from the fourth or fifth supply tray. When the paper is completely fed with the interruption of the operation of the base machine, the MOT#ON signal is turned off and the FTM enters the standby mode.

With respect to the operation of the large capacity tray (HCF), the size of paper stored on the large capacity tray is detected (HCF@SIZ) while the power is being supplied and transmitted to the base machine. The HCF elevator is simultaneously elevated and the HCFYRDY signal is turned on when paper is prepared for feeding. On receiving the MOT#ON thus turned on then, the HCF side enters the run mode and is placed in an HCF#ON signal standby state. On receiving the FCF#ON signal, the HCF side starts feeding paper. When the paper is completely fed with the interruption of the operation of the base machine, the MOT#ON signal is turned off simultaneously with the interruption thereof and the FTM enters the standby mode.

(6-7) Intermediate tray control system.

As set forth above, the paper trays fitted as additional devices include the intermediate tray, the large capacity tray, the fourth and fifth supply trays,]and the intermediate tray (DDM) among them is, as is obvious from the above description, subjected to complicated operation and controlling that it stocks and feeds copying paper put through a copying process and places the copying side of the paper upside down while stocking it, depending on the function for use. On the contrary, since the large capacity tray, the fourth and fifth supply trays, like other ones, are employed to supply paper, these trays are required only to function as feeders. Consequently, the latter trays are simpler in construction and control than the intermediate tray to the extent that what is equivalent to part of the intermediate tray is used in view of the control system. The details of an intermediate tray control system will subsequently be described.

FIG. **33** is a diagram illustrating a general tray control flow, whereas FIG. **34** is a diagram illustrating a stock control process flow for the intermediate tray.

The control of the intermediate tray will be outlined as follows: as shown in FIG. **33**, the selection of the intermediate tray is checked by the main controller and, when it is selected, the main controller examines whether the intermediate tray has actually been installed (Steps **1** and **2**). If the intermediate tray is installed, the main controller waits for the start button to be turned on and determines either duplex or dual mode is followed and further transmits either duplex or dual mode signal to the tray controller (Steps **3–6**). Moreover, the main controller waits until the register gate of

the base machine which controls the feeding of copying paper is turned on and transmits the signal indicating the on-state of the register gate thereof (commencement of copy-making operations) to the tray controller (Steps **7** and **8**).

On the other hand, the tray controller controls stock on the intermediate tray. When paper is stocked on the intermediate tray, the billing of the base machine is carried out (Steps **9–11**). The main controller then returns to Step **7** and repeats the aforesaid process until the set number of sheets of copying paper is stocked and waits for the intermediate tray to start feeding (Steps **12** and **13**).

The main controller transmits the feed signal to the tray controller to excite the intermediate tray feed control and repeats this process until the set number of sheets is fed (Steps **14–16**).

The stock control on the intermediate tray is, as shown in FIG. **34**, exercised in such a manner that the tray controller waits until the register gate of the base machine is turned on, examines whether the duplex mode is followed after it is thus turned on, controls duplex stock on the intermediate tray in the case of the duplex mode or otherwise dual stock thereon. This control is effected by changing the direction of the DDM inverter solenoid **364**.

A description will further be given of some examples of control characteristic of the DDM tray control.

FIG. **35** is a diagram illustrating a size identifying process flow while power is on. FIG. **36** is a diagram illustrating a control flow at the time of a DDM stock mode. FIG. **37** is a diagram illustrating a control flow at the time of DDM feeding. FIGS. **38–40** are illustrative of details of the process steps of FIGS. **35–37**.

(i) Control of the DDM tray-in solenoid.

As the intermediate tray **33** is designed so that the front ends of sheets of paper being fed have to be turned up, paper of various sizes cannot be sent in the same feed opening. For this reason, the paper feed opening of the intermediate tray **33** is switched by the DDM tray-in solenoids **355–357** according to the paper size. The switching operation of the DDM tray-in solenoids is defined by classifying the sizes of paper sent from the base machine into four kinds. For **A3** size, for example, the DDM tray-in solenoid **355** is turned on; for **B4** size, the DDM tray-in solenoid **356** is turned on; for **A4** and **B5** lengthwise, the DDM tray-in solenoid **357** is turned on; and for **A4** and **B5** crosswise, all of the DDM tray-in solenoids **355–357** are turned on.

(ii) Size identifying process while power is on (FIG. **35**).

Regarding a particular bit (bit **5** of FIG. **22**(*a*)), only the initial serial data becomes what determines whether paper for use is of the inch mode. Accordingly, whether the particular bit corresponds to inch mode setting data is examined and the inch or AB mode is set according to the setting data.

(iii) Control in the DDM stock mode (FIG. **36**).

The tray controller examines whether or not the main motor **164** of the base machine is held on and, while waiting in the standby mode until it is turned on, sets the run mode when it is turned on.

The tray controller waits until the register gate of the base machine is turned on and controls the register gate thus turned on. As shown in FIG. **38**(1), this control comprises the steps of guiding paper to the intermediate tray **33** by turning on the DDM gate solenoid **351** 1,000 msec later and setting the **E3-5** jam timer (on-state checking of the first DDM inverter sensor **352**) by turning on the DDM drive motor **361** and the HVPS illuminator **379** 2,800 msec later.

Then the tray controller waits until the first DDM inverter sensor **352** is turned on and, when it is turned on, it examines whether the duplex mode has been established and controls the first DDM inverter sensor in the on-state by means of the duplex mode when the answer is Yes and by the dual mode when it is No.

In the control of the first DDM inverter sensor in the on-state by the duplex mode, an **E3-5** jam timer is cleared as shown in FIG. **38**(2) (completion of the on-state checking of the first DDM inverter sensor **352**) and **E4-1** and **E4-2** jam timers are set (Off-state checking of the first DDM inverter sensor **352** and commencement of on-state checking of the second DDM inverter sensor **353**). In the control of the first DDM inverter sensor in the on-state by the dual mode, the **E3-5** jam timer is cleared as shown in FIG. **38**(3) and **E4-1** and **E4-2** jam timers are set and further the DDM inverter solenoid **364** is turned on.

After exercising the control of the DDM inverter sensor in the on-state by the duplex mode, the tray controller waits until the second DDM inverter sensor **353** is turned on, controls it in the on-state by the duplex mode, clears an **E4-2** jam timer as shown in FIG. **38**(4) (completion of the on-state checking of the second DDM inverter sensor **353**) and sets an **E4-4** jam timer on a paper size basis (commencement of the on-state checking of the DDM front sensor **372**).

Subsequently, the tray controller waits until the DDM inverter sensor **352** is turned off and controls the first DDM inverter sensor in the off-state. In this control, the tray controller clears, as shown in FIG. **38** (**6**), the **E4-1** jam timer (Completion of the off-state checking of the first DDM inverter sensor **352**) and turns off the DDM gate solenoid **351** when the set number of sheets has been passed therethrough.

The tray controller then controls the second DDM inverter sensor while waiting for the DDM inverter sensor **353** to be turned off. In this control, encoder pulses start being counted as shown in FIG. **39**(7) and, when **75** pulses have been counted, the tray controller turns on the DDM forward/backward switching solenoid **375** to invert the rotation of the forward/backward roller **368**, so that one of the DDM tray-in solenoids **355–357** corresponding to the paper size is turned on. By 75 pulse counts means the number of counts added during a period from the time when the rear end of paper passes through the second DDM inverter sensor **353** and further the DDM inverter solenoid **364** to the time when the paper has been conveyed up to the position where it can be inverted.

After controlling the DDM tray-in solenoids **355–357** in the on-state, the tray controller waits until the DDM front sensor **372** is turned on, clears the **E4-4** jam timer under the control of the DDM front sensor in the on-state as shown in FIG. **39**(8) (completion of the on-state checking of the DDM front sensor **372**), simultaneously sets an **E8-1** jam timer (commencement of the off-state checking of the DDM front sensor **372**) and controls the DDM front sensor in the off-state while waiting for the DDM front sensor **372** to be turned off. In this control, the tray controller clears, as shown in FIG. **39**(9), the **E8-1** jam timer (completion of the off-state of the DDM front sensor **372**), forwardly rotates the forward/back-

ward roller **368** by turning off the DDM forward/backward switching solenoid **375**, and turns on the skew solenoid **377** 1,170 msec later immediately when the set number of sheets has not been passed therethrough or by turning off the DDM inverter solenoid **364** and the HVPS illuminator **379** when the set number of sheets has been passed therethrough. The tray controller further controls the side guide 600 msec later than turning off the DDM tray-in solenoids **355–357** immediately until the skew solenoid **377** turns on the set number of sheets or by turning off the DDM tray-in solenoids **355–357** when the set number of sheets is turned on, and turns off the DDM drive motor when the set number of sheets has been stocked.

After controlling the DDM inverter sensor in the on-state by the dual mode, the tray controller controls the second DDM inverter sensor in the on-state while waiting for the second DDM inverter sensor **353** to be turned on, clears the **E4-2** jam timer as shown in FIG. **38(5)**, and sets the **E4-4** jam timer, whereby one of the DDM tray-in solenoids **355–357** which corresponds to the paper size is held on. Subsequently, like the case of the duplex mode, the tray controller waits for the DDM inverter sensor **352** to be turned off and controls the first DDM inverter sensor in the off-state. As in the case of the duplex mode, the tray controller waits for the DDM front sensor **372** to be turned on and proceeds to controlling the DDM front sensor in the on-state likewise.

(iv) Control at the time of DDM feed (FIG. **38**).

The tray controller examines whether or not the main motor **164** of the base machine is held on and, while waiting in the standby mode until it is turned on, sets the run mode when it is turned on.

The tray controller then performs a pre-feed preparatory process. In this process, the tray controller turns on the DDM drive motor **361** and the DDM tray solenoid **378** for moving the tray by 19 mm respectively and informs the main controller of the situation in which the tray is ready for operation about 1.2 sec later (after the period during which the tray moves by 19 mm).

Then tray controller waits until the DDM feed signal is turned on and controls the DDM feed signal in the on-state. In this control, the tray controller turns on the DDM feed clutch **363** and the DDM measure roll solenoid **358** as shown in FIG. **40(11)** to have the feed started and sets a **C6-1** jam timer (commencement of the on-state checking of the D/F/H sensor **369**).

The tray, controller further waits for the D/F/H sensor **369** to be turned on and control it in the on-state In this control, the tray controller clears the **C6-1** jam timer (termination of the on-state checking of the D/F/H sensor **369**) and turns off the DDM feed clutch **363** and the DDM measure roll solenoid **358** 300 msec later.

Subsequently, the tray controller waits for the D/F/H sensor **369** to be turned off and controls it in the off-state. In this control, the tray controller examines whether the set number of sheets has passed therethrough as shown in FIG. **40(13)** and turns off the DDM tray solenoid **378** when the set number of sheets has passed therethrough and further DDM drive motor **361** 1,000 msec later.

(v) Side guide control.

FIG. **41** is a diagram explanatory of the operation of a side guide with the intermediate tray viewed from the upside.

The intermediate tray **33** is arranged so that its rear side is normally positioned slightly in the recess of the paper feed line as shown in FIG. **41**(*a*). This arrangement is intended to prevent paper from mounting on the rear side edge of the intermediate tray **33**, provided the rear side is accurately mated with the feed line.

The paper on the intermediate tray **33** is set fre erelative to the feed and vartical directions and consequently the problem is that the paper tends to shift it position because of skew while it is fed and when the intermediate tray **33** is drawn out. The side guide is installed to prevent the paper shifting and the skew on the intermediate tray **33**.

The side guide **381** moves in the front direction shown by arrow A simultaneously when the DDM drive motor **361** is turned on and, after the home position is detected by the home position sensor **382** (GUIDE#HOME ON), then moves in the rear direction and stops at a position corresponding to the size of paper sent from the base machine, e.g., the width of paper +19 mm apart from the rear side of the intermediate tray. Provided the side guide **381** remains at the home position from the beginning, the main motor **164** of the base machine moves in the rear direction simultaneously when it is turned on. The paper **60** is sent onto the intermediate tray **33** in this state and, when the skew solenoid **377** is turned on/off, the side guide moves in the rear direction by 19 mm once and moves back in the front direction 19 mm again and then stops thereat while waiting the next supply of paper. When the set number of sheets of paper is sent in, the side guide **381** stops at a position equivalent to the width of paper as shown in FIG. **41**(*b*). When the paper thus sent in is fed, the side guide moves in the front direction to align the intermediate tray **33** with a paper feed line. The side guide is driven by a side guide motor **376**.

A stepping motor is employed as the side guide motor **376** and motor pulses are outputted from the tray controller **502**. Assuming a pulse of 294 PPS is used, the side guide will move at a speed of 125 mm/sec and covers a distance of approximately 0.425 mm per pulse. The control of the side guide in terms of the distance covered thereby is conducted by counting the pulses applied to the stepping motor. Moreover, the switching of the side guide motor back and forth at the time of paper alignment is effected in such a manner that it is stopped by two pulses.

FIG. **42** is a diagram illustrating a side guide control flow with the DDM front sensor in the off-state at the time of the stock mode. FIG. **43** is a diagram illustrating a side guide initial setting control flow in the stock mode. FIG. **44** is a diagram illustrating a side guide control flow at the time of DDM em,emergency interruption. FIG. **45** is a diagram illustrating a side guide control flow after the closing of the DDM tray interlock followed by the opening thereof in the feed mode.

In the control of the side guide with the DDM front sensor in the off-state at the time of the stock mode, the side guide motor **376** is, as shown in FIG. **42**, driven to move the side guide **381** to the rear side of the base machine by 19 mm and then stop it by two pulses. This is intended to completely stop the movement of the side guide **381** by making it absorb the inertia Subsequently, the side guide motor **376** is driven to move the side guide **381** to the front side of the base machine by 19 mm and, provided the set number of sheets been stocked, to stop it by two pulses. The side guide **381** is

then moved to the rear side of the base machine by 19 mm again.

In the initial setting control of the side guide in the stock mode, the guide home sensor **382** is, as shown in FIG. **43**, examined if it is in the off-state and, if it is in the off-state, the side guide **381** is moved to the front side of the base machine until it is turned on. The side guide **381** is further moved up to a position corresponding to the sum of the paper size and 19 mm.

In the control of the side guide at the time of DDM emergency interruption, the DDM emergency interruption is always monitored at the time of stock operations as shown in FIG. **44**. At the time of the DDM emergency interruption, the side guide is moved to the rear side of the base machine by 19 mm after it has reached to the position corresponding to the sum of the paper size and 19 mm. In other words, when the base machine stops operating because of jamming or interlock opening while the DDM is performing the stock operations, the DDM makes an emergency stop. If the side guide **381** is stopped immediately at this time, the paper stored in the DDM is left free. Moreover, if the tray is drawn out in that state to cause paper shifting, jamming and skew may occur when the operation is restarted. No problem is posed while the side guide **381** remains at the paper size position without performing the stock operations. While the side guide **381** performs the stock operations, i.e., when the side guide is not located at the paper size position, however, it is moved to and stopped at the paper size position after confirming the position corresponding to the sum of the paper size and 19 mm as its reference operating position. This is because, if the side guide **381** is moved without confirming the position corresponding to the sum of the paper size and 19 mm, the position at which the side guide is stopped will shift from the paper size position.

In the control of the side guide after the closing of the DDM tray interlock followed by the opening thereof in the feed mode, the side guide **381** is moved to the front side of the base machine until the guide home sensor **382** is turned off, i.e., it is moved over the position of the guide home sensor **382** once while the guide home sensor is held off when the DDM tray is switched to cause the tray interlock **371** to be on/off as shown in FIG. **45** and then it is moved to the paper size position.

As is obvious from the above description of the present invention, the serial communication lines connect the main controller for controlling the paper trays, and control signals instructing data regarding kinds and size of paper in stock, emergency interruption, etc. are transmitted from the main controller to the intermediate tray, whereas the tray controller sets stock preparatory conditions with the kinds and size of paper thus instructed, and the stock operation is completely performed even when the emergency interruption of the operation of the base machine occurs during the stock operation to ensure that paper is kept in stock on the intermediate tray. Moreover, even if the operation of the base machine is interrupted in case of emergency because of jamming and interlock opening while paper is being laid in stock on the intermediate tray, the paper in stock is surely held by the side guide, whereby the paper is never set free. Accordingly, paper is prevented from being shifted as the tray is drawn out and, even when the operation of the base machine is restarted, the paper is prevented from being shifted because of jamming and skew. Further, by transmitting data on the kinds and size of paper on a bit basis, quantity can be minimized and, particularly by providing the data on the kind of paper only through initial data transmission, the relevant bits can be allotted to the transmission of other items of data on and after second occasion, so that data transmission efficiency because improvable.

What is claimed is:

1. A paper tray control system, comprising:

a recording apparatus for recording image data on a paper, to which additional devices are attachable;

paper tray means installed in said recording apparatus as said additional devices for stocking the paper on which the image data has been recorded;

main control means for controlling said recording apparatus and for generating an instruction;

tray control means, separated from said main control means, for controlling said paper tray means;

communication line means connected between said main control means and said tray control means, wherein said tray control means receives said instruction from said main control means through said communication line means to control said paper tray means according to said instruction; and

wherein said tray control means is provided with memory means which stores programs for controlling said paper tray means.

2. A paper tray control system as claimed in claim **1**, wherein said communication line means comprises a serial communication line.

3. A paper tray control system as claimed in claim **1**, wherein said paper tray means comprises an intermediate tray having duplex and dual modes for temporarily accommodating the paper already used for recording at least once.

4. A paper tray control system as claimed in claim **1**, wherein said paper tray means comprises a large capacity tray.

5. A paper tray control system as claimed in claim **1**, wherein said paper tray means comprises an additional paper supply tray.

6. A paper control system as claimed in claim **1**, wherein said tray control means is provided with a paper stock control mechanism for controlling the stock of a paper in said paper tray according to said instruction from said main control means.

7. A paper tray control system as claimed in claim **6**, wherein said paper tray means is an intermediate tray having duplex and dual modes.

8. A paper tray control system as claimed in claim **6**, wherein said communication line means comprises a serial communication line.

9. A paper tray control system as claimed in claim **6**, wherein data on kinds of paper is transmitted with a bit different from that used for size designating data through said communication line means from said main control means to said tray control means.

10. A paper tray control system as claimed in claim **6**, wherein said tray control means makes the operation of said paper stock control mechanism stop after a predetermined period of time from the time when said tray control means receives an emergency interruption instruction from said main control means.

11. A paper tray control system as claimed in claim **6**, wherein said paper stock control mechanism is provided with guide means which moves to a paper stock position corresponding to paper size from the outside of paper to be stocked to stop at the time when stock operations are terminated.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,970,544

DATED : November 13, 1990

INVENTOR(S) : Tsutomu Furusawa et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page, Foreign Application Priority Data, change "304169" to --62-304169--;

Claim 6, Column 40, Line 40, after "paper" insert --tray--.

Signed and Sealed this

Eighth Day of December, 1992

Attest:

DOUGLAS B. COMER

Attesting Officer

Acting Commissioner of Patents and Trademarks